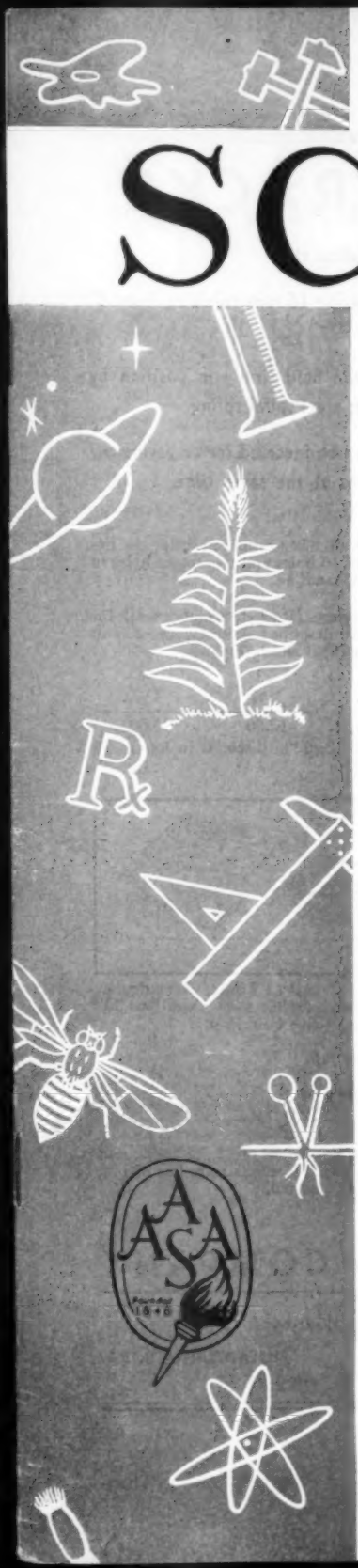

SCIENCE

6 AUGUST 1954

VOLUME 120 NUMBER 3110

Contents

Review of Some Methods of Flow Measurement: *W. A. Wildhack* 191

Irradiation of Parts of Individual Cells, II: *Robert B. Uretz, William Bloom, Raymond E. Zirkle* 197

Rudolf Höber: His Life and Scientific Work: *William E. Amberson* 199

News and Notes

Recent Advances in Astronomy; Philippine Science; and Regular Departments 202

Book Reviews

Silicones and Their Uses; Methods of Theoretical Physics; Les Groupes Sanguins Chez les Animaux; Automatic Digital Calculators; Microwave Spectroscopy and *Microwave Spectroscopy; The Metabolism of Algae; Introduction to Tensors, Spinors, and Relativistic Wave-Equations; An Illustrated Catalogue of the Rothschild Collection of Fleas in the British Museum; Quantitative Organic Analysis via Functional Groups*; Books Reviewed in *The Scientific Monthly*; and New Books 212

Miscellaneous Publications 217

Technical Papers

Dissociation of Chick Embryo Cells by Means of a Chelating Compound: *Edgar Zwilling* 219

Crystalline Neoretinene b: *John M. Dieterle* and *Charles D. Robeson* 219

Radical Dissociation of Aryldisulfides: *H. Z. Lecher* 220

Isolation and Identification of "Bound" Morphine: *R. A. Seibert, C. E. Williams, R. A. Huggins* 222

Chemical Similarity and Biological Activity of the Saponins Isolated from Alfalfa and Soybeans: *George C. Potter* and *Fred A. Kummerow* 224

Tumor Induction in *Drosophila melanogaster* by Injection of $e^{35}ts$ Larval Fluid: *M. H. Harnly* et al. 225

Serologic Differences in Strains of Herpes Simplex Virus: *C. Ray Womack* and *Brewster P. Hunt* 227

Nonmarine Miocene Arthropods from California: *Allison R. Palmer* and *Allen M. Bassett* 228

Inhibition of Virus Infections of Certain Plants by Extracts from *Capsicum frutescens* L.: *C. D. McKeen* 229

Communications

Glycogen Deposits in Gingival Tissue: *Margaret R. Dewar* 230

Dust-Snow Storm in the Minneapolis–St. Paul Area on 12 March 1954: *N. Prokopovich* 230

Fluorometric Determination of N^1-Methylnicotinamide: *Harold L. Rosenthal* 231

New Enemy of the Oyster Drill: *Franklin B. Flower* 231

Brochosomes and Leafhoppers: *G. S. Tulloch* and *J. E. Shapiro* 232

Limitations of the Symmetry Criteria for Optical Inactivity and Resolvability: *Kurt Mislow* 232

Some Problems Concerning the Distribution of the Late Paleozoic Gastropod *Omphalotrochus*: *Ellis L. Yochelson* 233

Ultra-Fine-Grained Light-Sensitive Film of Optional Density: *M. J. Olsen* 234

"I Don't Want To Be Quoted by the Press" 7A

Meetings & Conferences 10A

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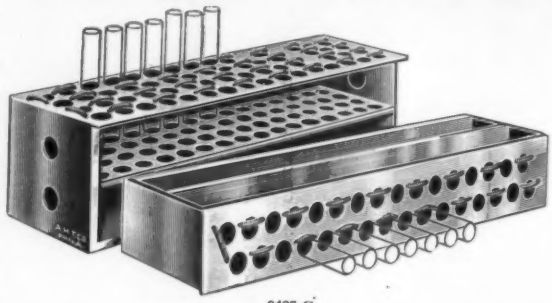

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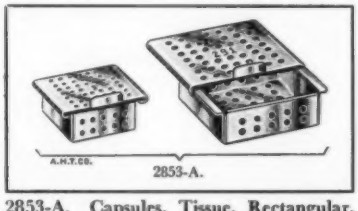

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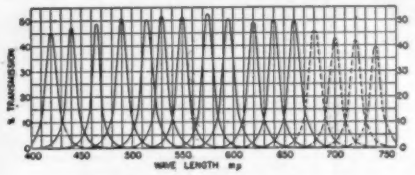

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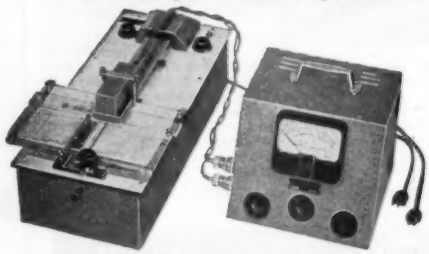

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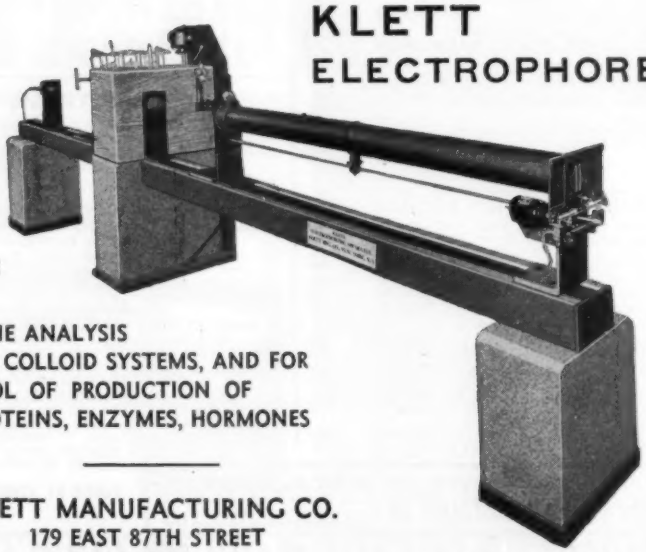

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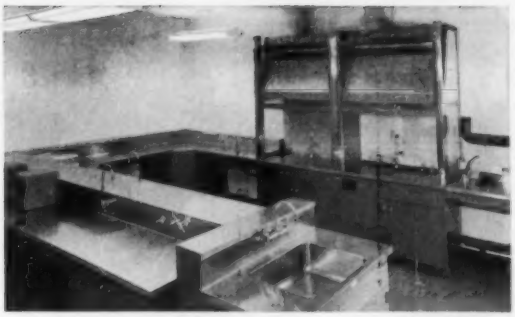

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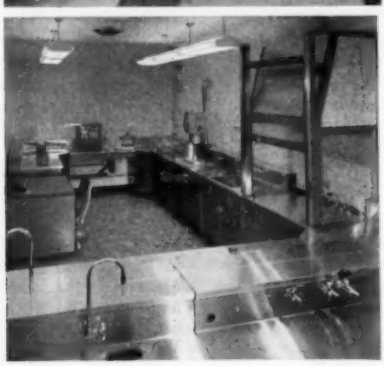

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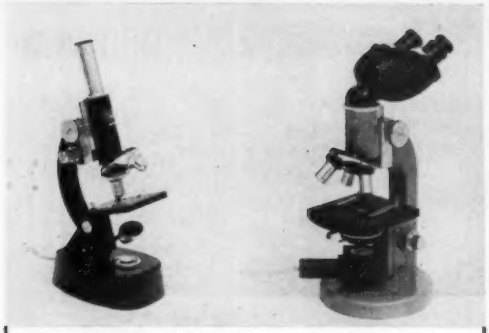

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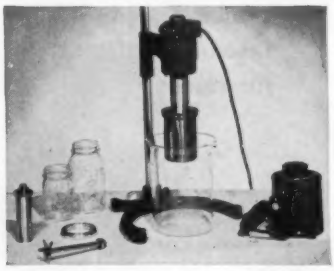

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A CONFERENCE on "Mass communication" was held in June at Ann Arbor under the auspices of the University of Michigan department of journalism and concurrently with the American Institute of Chemical Engineers' "International nuclear engineering congress." One feature was a panel discussion devoted to problems that face journalists and scientists in preparing news releases on scientific topics. Its short title, as given on the printed program, was "I don't want to be quoted by the press." This might strike one as ironical. How can a scientist avoid being quoted in these days if he is producing anything significant or has ideas or information that are worth quoting?

Any competent scientist who publishes or speaks—even before professional groups—or who grants interviews must be prepared and willing to be quoted. Certainly courage is needed, especially in an atmosphere of fear, to speak out on some matters. But the "dangerous" topics are likely to be the very ones that irresponsible individuals outside the sciences are most willing to tackle, freely and without restraint. Even though such people may possess the facts, this will count for little if they are guided by a well-known formula for one kind of success: the truth be damned; tell the public what it wants to hear. So it is not only within Government proper that we must seek to maintain the principle of checks and balances. Help is also needed from scientists who not only know the facts but are ingrained with the ideal of intellectual honesty.

Of course there are times not to speak out. Perhaps the necessary facts are lacking; or questions may be asked that, for legal or ethical reasons should not be answered. But even then a person must be prepared to be quoted. His *No comment* may prove to be news and perhaps will rate an interpretation. Yet the right to say *No* is part of our right to speak freely. A sensible person will practice various ways of saying *No* until he hits on one that arouses a minimum of resentment. A snappy *No comment* seemingly is not one of these ways, according to some of our advisors among the members of the press.

Obviously there is one way to play safe: make a deal with an interviewer that words can be quoted, provided that name and institutional connections are withheld; or let a document get "lost" in a suitable place; and so on. Information thus obtained is often delicately referred to as having come from "a reliable source"; but there are other less polite names for such a source.

Any person pursuing a science who indulges in such practices simply is not playing the game according to the rules. He is violating—it is being done too often these days for comfort—parts of a code involving ideals, attitudes, and character traits that has been in the making for some 20 centuries. This code comprises a number of articles, but two of them of importance here are intellectual honesty and possession of the courage of one's convictions. To ignore a single article of this code is to contribute materially to the weakening of the scientific endeavor. If we undermine any appreciable part of the code, creative science will disappear and, for that matter, so also will our Western civilization as we have known it.

Thus only two courses seem to be open: either to speak out publicly or tactfully to say nothing. Admittedly, some journalists have noted an increasing tendency among scientists to seek publicity for their institutions or themselves, often for obviously selfish reasons. However, our present concern is with the men of science who have something to say that the general public really needs to hear.—D.R.

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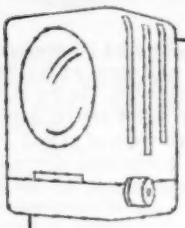

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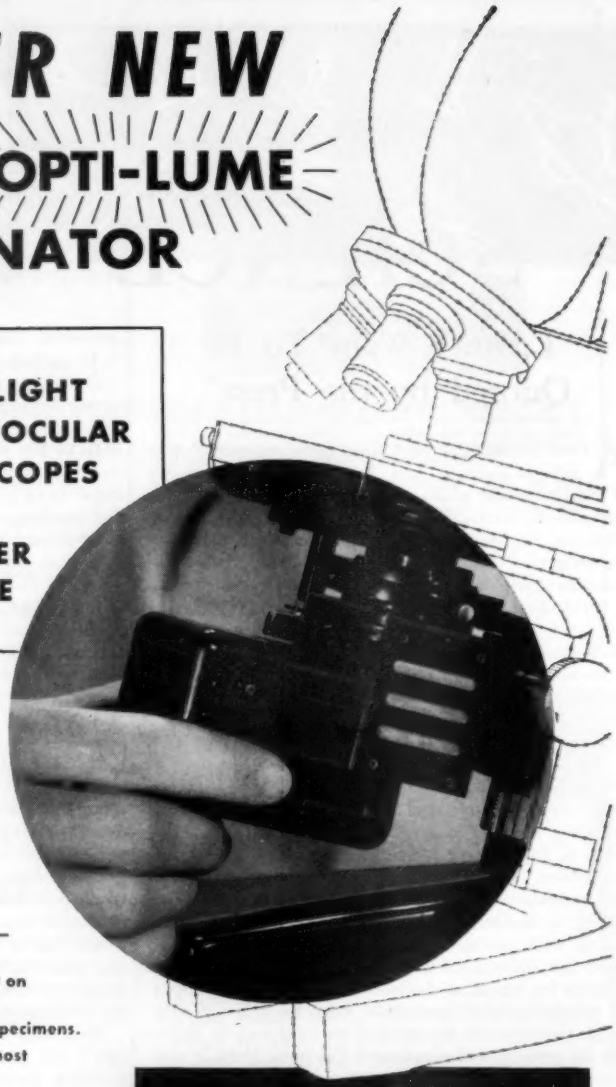

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Review of Some Methods of Flow Measurement

W. A. Wildhack

National Bureau of Standards, Washington 25, D.C.

IN the space allotted for this review (*1*), it will be possible to mention only a few of the more recent or more interesting developments in flow measurement, and these only briefly. The instruments or methods selected for mention include range extension for rotameters, critical-flow nozzle, viscous-resistance elements, acoustic flowmeter, electromagnetic induction flowmeter, and "mass" flowmeters of several types.

In speaking about "rate-of-flow" measurements, one must always distinguish between "volume flow" and "mass flow." Many of the conventional methods or devices for flow measurement unfortunately do not measure either one or the other but give indications that are some sort of hybrid functions requiring further measurements of the density (or velocity) in order to determine the flow, either on a volume basis or on a mass basis. The conventional flow orifices or nozzles illustrate this difficulty. For these, the pressure drop is proportional to the density of the flowing fluid and to the square of the velocity of the fluid. Thus, when used to measure the volume flow—in, say, gallons or cubic feet per minute—the quadratic expression has to be corrected for the density. Conversely, in determining the mass flow—in, say, pounds of mass per minute—one must again make a correction and determine separately either the density or the velocity in order to interpret the pressure drop across the orifice in terms of the mass flow. These factors should be kept in mind in considering the brief discussions that follow.

Range extension for rotameters. A rotameter consists of a tapered tube in which a "float" (ball, cylinder, disk, or other shape) is lifted, against gravity, by the flow to a level where the area of the annular orifice between tube and float will pass the flow with a pressure difference just sufficient to suspend the float. It is one of the most versatile devices for measurement of flow, widely used nowadays because it gives indications that vary directly with the flow rather than with the square of the flow, as does the conventional flow orifice. However, it too has the disadvantage that its indication is also affected by the density of the fluid. The ways in which the rotameter reading can be partially corrected for variation in density of the fluid and made reasonably free from variation with viscosity and other properties of the fluid have been explored in detail in recent years (*2*).

There are some tricks, which have not appeared elsewhere in the literature, whereby the versatility and usefulness of the rotameter may be enhanced for certain laboratory or plant applications. Since the weight of the float is constant, the pressure drop across the float is essentially constant, except for flows smaller or larger than the nominal range of the instrument. When the flow is too small to lift the float from its seat, the annular orifice around the float is of a constant size, and small flows will give a pressure drop across the rotameter that varies in the same way as the pressure drop across any fixed orifice. A water manometer, or other differential-pressure measuring gage, connected between top and bottom of the rotameter, as in Fig. 1, will therefore give an indication for the range of small flows before the float lifts. As the float rises, the pressure drop remains constant throughout the scale range of the rotameter. When this range is exceeded, the float is held against the stop at the top of the instrument and again forms a fixed orifice across which the excess flow will cause an increased pressure drop. So, by the simple addition of a water manometer, indications may be obtained of flows both below and above the scale range of the rotameter. There is, of course, some lack of accuracy to be expected if the rotameter float is not guided to exact seating at both ends of its travel. Figure 1 illustrates a typical curve of pressure difference as a function of flow.

Another application of this same characteristic of the rotameter, which is not as widely used as it might be, is the utilization of a small-range rotameter to monitor much larger flows whose incremental variations lie within that range. This is accomplished by installing the rotameter, as is shown in Fig. 2, in

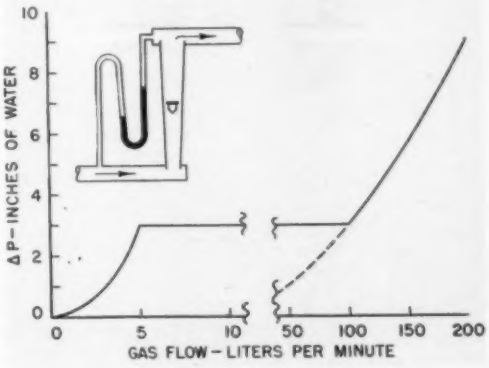

Fig. 1. Rotameter range extension.

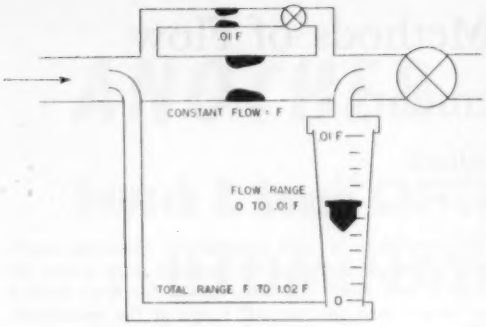

Fig. 2. High-precision flowmeter.

parallel with a flow orifice or nozzle of such size that the major part of the flow, say 90 or even 99 percent, goes through the orifice when the pressure drop across it rises to the value required to support the rotameter float. Under these conditions, any variation in flow will be shown almost entirely on the rotameter. The provision of an additional parallel branch, as shown, allows a selection of the flow range in which variation may be observed.

It should be pointed out that in many "bypass" installations of rotameters an entirely different theory is involved and entirely different results are obtained. A second orifice is installed in series with the bypass rotameter, so that the pressure drop across the rotameter is nearly negligible in comparison with the pressure drop across either the bypass orifice or the main orifice. Under these conditions, the rotameter indicates approximately a constant fraction of the total flow.

Critical-flow nozzle. A device that gives a flow of gas proportional to the absolute pressure is the so-called "sonic," or "critical-flow," nozzle, which is an ordinary nozzle with rounded approach (Fig. 3) operating under conditions such that the absolute pressure p_2 in the throat is less than about half the absolute pressure p_1 at the inlet. Under these conditions, the gas velocity at the throat of the nozzle is equal to the velocity of sound. Since the velocity of the discharge at the throat cannot exceed this value, the volume flow remains constant, regardless of variation in the downstream pressure, as long as the pressure ratio p_2/p_1 is less than the critical value of approximately one-half. (From the curves in Fig. 3, it is seen that this is only approximately true for the sharp-edged orifice.) The volume flow will vary with the temperature, which affects the velocity of sound. The mass flow will also depend on the entrance pressure and temperature, since they affect the density. (For pressure ratios nearer unity, the flow through the nozzle or orifice is given by the familiar equation relating it to the square root of the pressure difference.)

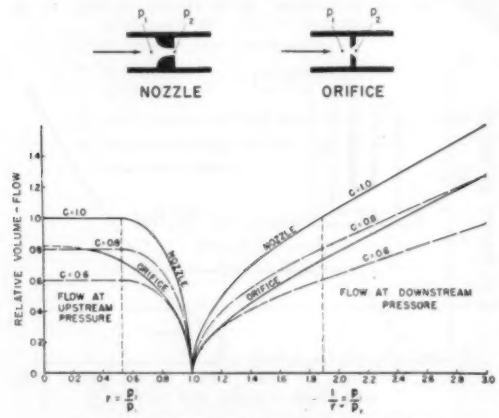

Fig. 3. Flow chart for nozzles and orifices.

Inasmuch as the absolute pressure of a gas can easily be measured with high accuracy, the critical-flow nozzle furnishes a means for accurate determination of flow. The disadvantage of the relatively low throat pressure p_2 required may be somewhat compensated by the use of nozzles with divergent exhaust cones, which increase the pressure at the cone exit. In the laboratory of the Office of Basic Instrumentation at the National Bureau of Standards, we have been able to obtain critical discharge with an over-all pressure ratio as high as 0.8. Although this interesting and useful property of the flow nozzle has been known for 75 yr, the device is not as widely used as its accuracy would appear to warrant. I have used critical-flow nozzles in a series of instruments for mechanical gaging, for measurement of temperature, and for gas analysis (*3*).

Viscous-resistance element. In addition to rotameters, there is another class of flowmeters that gets away from the quadratic pressure-flow characteristic of the orifice or nozzle. This is the class of so-called "linear resistance" flowmeters, in which the movement of the fluid is not turbulent, but laminar. Flow of this type occurs when a fluid moves slowly through a capillary tube or through closely packed granular or fibrous material. The standard equation for the pressure drop Δp associated with fluid flow in a long capillary tube is

$$\Delta p = KV\mu L/R^2 = Q_m \frac{8\mu L}{\pi R^4}$$

where K is a proportionality constant, V is the average velocity, μ is the coefficient of viscosity, L is the length of the tube, R is the radius of the tube, and Q_m is the volume flow-rate. For gas flow, Q_m is the volume flow-rate at the mean absolute pressure in the tube.

By using a bundle of capillary tubes, one may increase the capacity of the assembly to any practical value desired. Although the equation indicates that the over-all pressure drop is directly proportional to the flow-velocity, there is actually a small additive quadratic effect occasioned by pressure drops at inlet and outlet, so that the over-all relationship is not always exactly linear. Disks of sintered glass or metal show a characteristic almost like that of the capillary bundle, but, perhaps because of the wide varia-

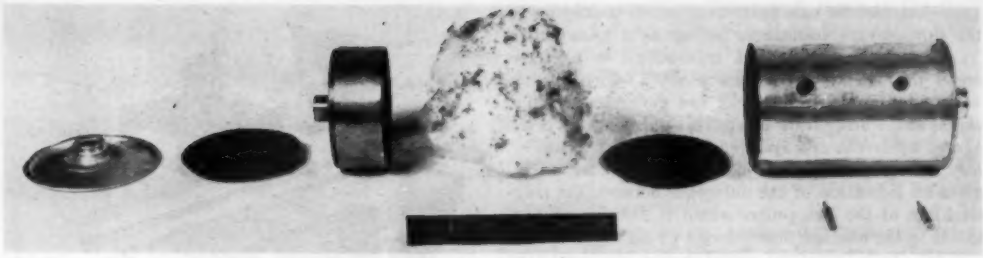

Fig. 4. Components of a simple linear flowmeter.

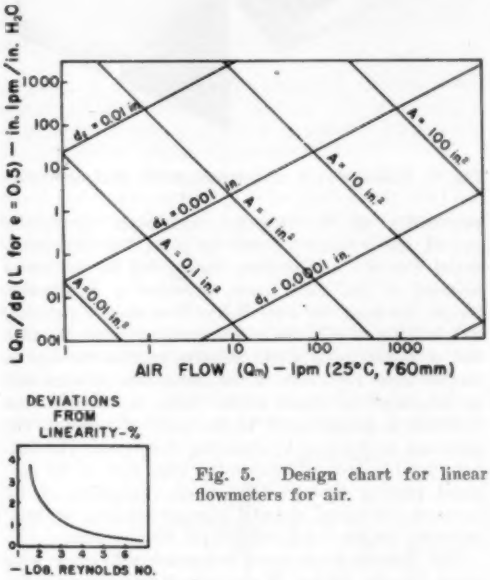

Fig. 5. Design chart for linear flowmeters for air.

tion in the size of their pores, they seldom show exact linearity.

Figure 4 shows the components of a very simple type of linear flowmeter developed several years ago at the National Bureau of Standards. It consists of glass-wool fibers packed into a metal canister, with pressure taps inserted in the canister in such a way that the glass wool at each end of the canister serves as a filter, and the pressure drop is measured across the intermediate part of the glass-wool pack. Figure 5 indicates the wide range of design parameters available in such meters for air, giving flows from a fraction of a liter per minute to hundreds of cubic feet per minute. There is some rather difficult theory involved in trying to predict the pressure drop resulting from flow through packed fibers (*4*), but the chart gives an empirical value $LQ_m/\Delta p$ which indicates what the pressure drop Δp will be for any combinations of length L, cross-sectional area A, fiber diameter d_f, and flow Q_m. The $e = 0.5$ in Fig. 5 means that the fibers are packed half as tightly as they can conveniently be packed under standard conditions. When the fluid is compressible, one must specify whether the measurement is in terms of the flow that goes in or the flow that comes out. Since the pressure is different upstream and downstream, the volume flow-rate is greater on the downstream than on the upstream side. Only for the volume flow-rate as measured at average pressure is the calibration exactly a straight line (*5*).

Although the pressure drop across such flowmeters is a viscosity phenomenon and might be expected to be independent of gas density, there is nonetheless some slight correction to be made where gases are measured at very low pressures. Although this correction is negligible for most applications, the slope of the calibration curve may change by as much as 5 percent for air at an absolute pressure of 3 lb/in.², the volume flow being this much greater than at pressures near atmospheric.

Acoustic flowmeter. It has long been known that sound travels faster downwind than upwind, and various devices have been proposed or made for measuring flow by measuring the difference in the velocity of sound in the two directions (*6*). Further development of this idea at the National Bureau of Standards has resulted in the acoustic flowmeter illustrated schematically in Fig. 6 (*7*). A very short high-frequency sound pulse is generated by one of the transducers

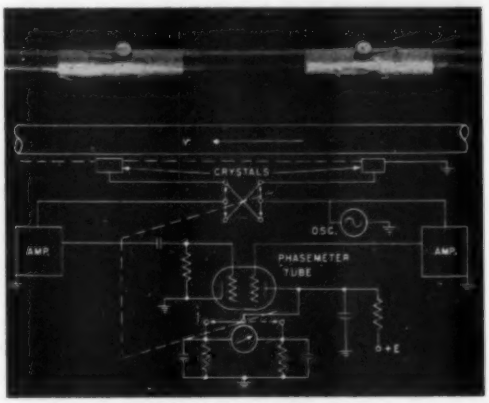

Fig. 6. Acoustic flowmeter.

(for example, the one upstream) and is picked up by the downstream transducer acting as a microphone. The signal thus received is transmitted to a phasemeter through a synchronous rectifier, which also reverses the circuit connections and generates a sound signal at the other transducer. This pulse is then propagated upstream and received by the first transducer, now acting as a microphone. The phasemeter circuit gives an indication of the difference between the transit times of the two pulses which is directly proportional to the average flow-velocity of the fluid.

When high-frequency sound waves are used, the sound path appears to be one of multiple reflections, so that the velocity indicated is very accurately the average velocity across the flow channel. The accuracy is about 1 percent or better down to velocities of 1 cm/sec. Although this device has at present 23 vacuum tubes in the electronic circuitry, it nevertheless has attractive possibilities for many industrial applications because nothing needs to be inserted in the flow channel, and measurements may be made from the outside of the conduit. At present it has been developed only for use on plastic tubes. However, it probably could be applied to metal pipes, particularly if spacings between the electrodes exceeding the present 5 or 6 in. can be provided.

Electromagnetic induction flowmeter. Any object, solid or fluid, conductor or nonconductor, that moves in a magnetic field has a voltage generated in it, in a direction perpendicular to the magnetic field and to the direction of motion. This effect was put to practical use in the electric generator some 30 or 40 yr after its discovery in 1830, but not until about 1930 was it applied to measurement of the flow-velocity of liquids, by Williams (*8*) in England and Kolin (*9*) in the United States. The first application of this principle was in measuring the flow in blood vessels that were partially excised from the body so that magnetic poles could be applied to them and electrodes could be fastened to them at right angles to the magnetic field. In recent years, the device has been developed for other laboratory and industrial applications (*10*), and installations have been made on pipe sizes as large as 20 in. in diameter. Figure 7 is a cutaway view illustrating the relative positions of electrodes, magnetic field, and flow tube.

Advantages of the electromagnetic flowmeter are that it has no moving parts and offers no obstruction to the flow. However, the voltages generated are relatively small, and the high electric resistance of many liquids makes it necessary to use very high impedance amplifiers to measure the signal.

Coriolis-force mass flowmeter. A meter that utilizes Coriolis acceleration as a means of measuring mass-rate of flow has been described by Y. T. Li and S. Y. Lee (*11*) and is shown in Fig. 8. A constantly rotating shell is inserted in the pipe line, and the fluid moves in a spiral path from the axis out to the periphery, guided by a disk set with radial guide vanes. The fluid then returns to its axial flow through another set of rotating guide vanes, delivering to them

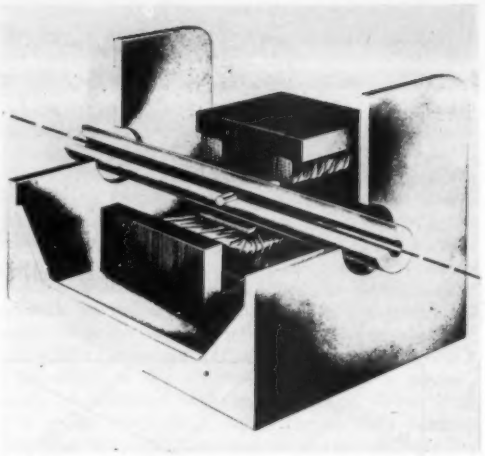

Fig. 7. Cutaway view of electromagnetic fluid flowmeter.

practically all the angular momentum previously gained, and continues down the pipe. The circumferential Coriolis acceleration, multiplied by the mean moment of the fluid mass, provides a measurable torque between the two disks. The second rotating disk is integral with the rotating housing, but the first one is permitted a slight relative motion through a torque tube. The twist of the latter can conveniently be measured by strain gages. Since the torque that is sensed is proportional to the speed of rotation, the scale can be changed by changing this speed. The output signal is proportional to the mass flow of the material passing through the vanes, regardless of its pressure, viscosity, density, compressibility, or temperature, or the frictional torque requirement.

The Coriolis-force mass flowmeter will work with gases, liquids, foams, or slurries. It is adaptable for measurement of rapidly changing flow in either direc-

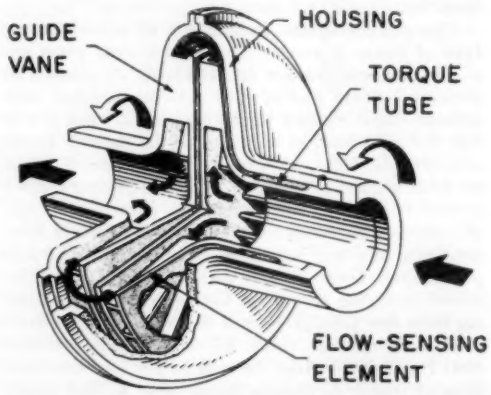

Fig. 8. Coriolis-force mass flowmeter. [Courtesy Control Engineering Corp., Norwood, Mass.]

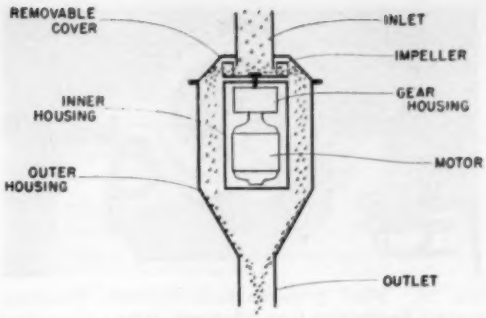

Fig. 9. Schematic drawing of the "massometer." [Courtesy Wallace & Tiernan, Belleville, N.J.]

tion, but it has the disadvantages of two large-diameter rotating seals and the need for a constant-speed drive. Accuracy is said to be within ± 0.3 percent and sensitivity within 0.1 percent (*12*).

Spin-torque mass flowmeter. A mass-flow device called the "massometer" (*13*) is particularly adapted for free-flowing granular material. It has a rotating impeller disk mounted on the upper end of a 1/20-hp, 1800-rev/min synchronous motor, the whole unit being enclosed in a dust-tight case (Fig. 9). The material falls on the central area of the impeller disk and moves outward as a result of centrifugal force, gaining the same tangential velocity as the edge of the impeller disk before it is slung off, to drop past the motor to an outlet below. The torque required of the motor, above that needed to overcome friction, is proportional to the mass flow. This torque reacts on the motor stator, turning it slightly about the rotation axis against the force exerted by an aneroid capsule (Fig. 10). The air pressure in this capsule is controlled through a nozzle and a flapper linked to the stator, via an air-relay valve supplied at 30 lb/in.^{2} The same pressure actuates the pen on a conventional pneumatic recorder. The accuracy is stated to be ± 1 percent between 10 and 100 percent of capacity, which may be 30 to 200 lb/min (*14*).

Helical-flow cylinders. A mass flowmeter developed for measurement of aircraft fuels of various viscosities and densities was described by V. A. Orlando and F. B. Jennings (*15*). The sensing unit consists of two similar rotatable cylinders, called impeller and turbine, placed end-to-end in the pipe line (Fig. 11). The instrument housing closely fits their outer diameters. The central area of these cylinders is blanked off, but the peripheries are provided with a number of shrouded parallel passages. The upstream cylinder, rotated continuously at a constant speed, imparts to the fluid moving through it an angular momentum proportional to the moment of inertia of the fluid and, hence, to the mass-rate of fluid flow. The downstream cylinder is designed to remove this momentum, and the resulting torque turns it through an angle against the restraint of two calibrating springs. It was found desirable to shroud the two cylinders and to provide a decoupling disk between them to eliminate viscosity effects.

For measuring fuel flow to individual engines (*16*), a special generator furnishes three-phase, 400-cy/sec power to the impeller motor, submerged in the fuel and thus lubricated and cooled. A gear train drives the impeller at 63 rev/min. The external dimensions of the transmitter are approximately 3½ by 3½ by 10½ in. The pressure drop is only 0.81 lb/in.^{2} for a flow-rate of 12,000 lb/hr, and the speed of response is less than 2 sec across half scale. The motor incorporates a chronometric governor to maintain a constant speed of 2700 rev/min with an accuracy of 0.1 percent. The angular position of the turbine is transmitted to a remote indicator by a second-harmonic type selsyn system. The error-of-flow indication is given as about 0.2 percent of full scale in the range

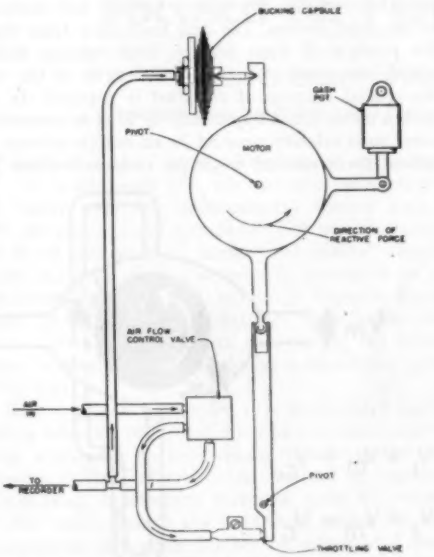

Fig. 10. Schematic of the force-balance system of the "massometer." [Courtesy Wallace & Tiernan, Belleville, N.J.]

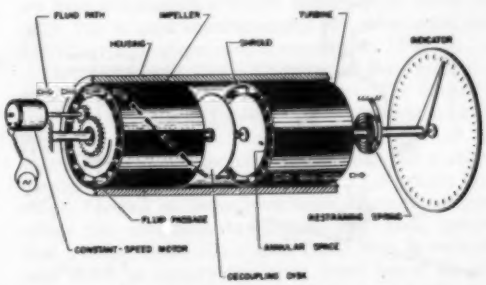

Fig. 11. Mass flowmeter using helical-flow cylinders. [Courtesy General Electric Co., West Lynn, Mass.]

0 to 3000 lb/hr and about 1 percent in the range 3000 to 12,000 lb/hr. A six-engine installation weighs only 40.8 lb.

Fluid gyroscope mass flowmeter. A mass flowmeter operating on the gyroscopic principle is described in a patent issued to J. M. Pearson (*17*). In this device, the fluid is led through a pipe coil, which is either rotated or oscillated about an axis (precession axis) in the plane of the coil. The circulation of the fluid in the coil provides an angular momentum that is the product of the moment of inertia of the fluid and its angular velocity about an axis perpendicular to the plane of the coil. Owing to the precession (rotation or oscillation), there results a gyroscopic torque, about an axis perpendicular to the other two, that is a measure of the mass-rate of fluid flow.

Figure 12 shows a schematic oscillatory arrangement, under study by the Office of Basic Instrumentation, that is intended to eliminate the rotational seals and permit torque measurement by piezoelectric devices. The Pearson patent includes a mechanical gyroscope that is automatically maintained at such a rotational velocity as just to balance the torque exerted by the mass moving through the coil, this angular velocity being then a measure of the mass flow-rate. The commercial device (Fig. 13) is a rotating form, available in various sizes and materials (*18*). It is adaptable to applications requiring low-frequency response or the averaging of pulsating flows and is expected to give resolution in the handling of gases, liquids, and some fluidized solids.

Magnus-effect mass flowmeter. (i) *Pressure from transverse rotor.* A mass flowmeter, developed by W. J. D. Van Dijek of the Technical University of Delft, was engineered by the Royal Dutch Shell Laboratory and has been described by D. Brand and L. A. Ginsel (*19*). A constant-speed smooth-surfaced cylinder (Fig. 14) rotates about an axis transverse to the fluid flow, which is led around both sides of the rotor through gradually narrowing passages. The velocity of the fluid in one gap is increased, and that in the other is decreased in the same amount, because of the film adhering to the rotor. The difference of the pressures measured at the two gaps proves to be directly proportional to the product of the fluid density, the surface speed of the rotor, and the equivalent undisturbed stream velocity.

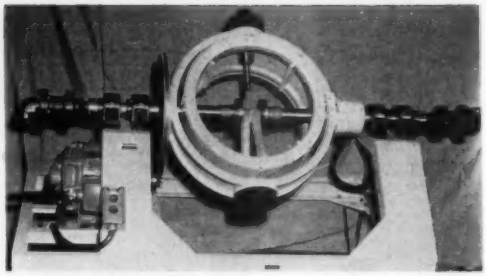

Fig. 13. Fluid gyroscope mass flowmeter. [Courtesy Control Engineering Corp., Norwood, Mass.]

Three prototypes of the Van Dijek mass flowmeter were built, the last for measuring a pulsating flow of 1000 metric tons of oil per day with a differential pressure of 72 in. of water. It was found that the velocity of the main flow should be kept well below critical, but that the output was substantially linear even with pulsating flows and liquids of widely different viscosities. The pressure drop across the meter is about one-fourth of the measuring-pressure differential. Attempts were made to use this meter for an air-liquid mixture, but the results were unsatisfactory.

Magnus-effect mass flowmeter. (ii) *Force on transverse rotor.* A mass flowmeter conceived by H. L. Mason, and now under study by the Office of Basic Instrumentation, utilizes the Magnus effect in conjunction with an elastic member. This has a constant-speed rotor (Fig. 15) with a vertical axis transverse to the fluid stream. The axis sustains a force that is the product of mass density, fluid velocity and the speed, cross-sectional area, and length of the rotor. No special shaping of the duct is required. In fact, such a meter could apparently be used to measure the local mass-velocity product in an infinite stream. The lateral force exerted might be measured either by a

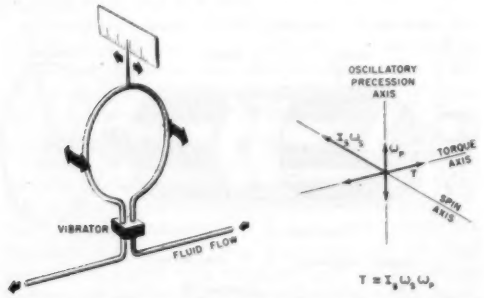

Fig. 12. Schematic drawing of the "vibro-gyro" mass flowmeter.

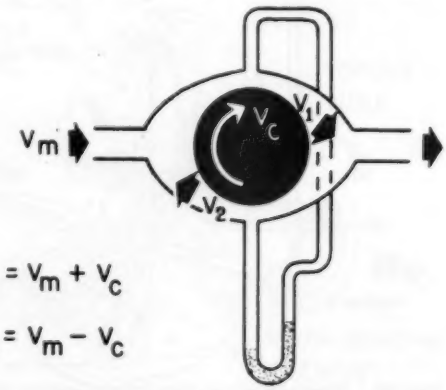

Fig. 14. Schematic drawing of end view of the Van Dijck mass flowmeter.

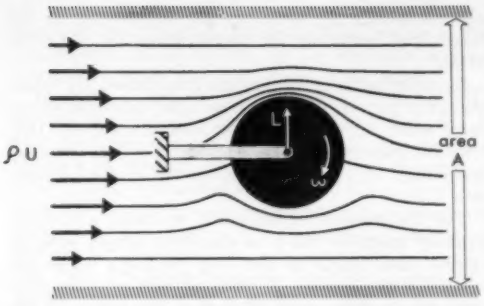

Fig. 15. Schematic drawing of mass flowmeter using Magnus effect.

pneumatic force-balance arrangement or by the calibrated deflection of a cantilever beam lying on the axis of fluid flow.

References and Notes

1. Based on a lecture presented at the Fifth Annual Southeastern Symposium on Industrial Instrumentation, 1–3 Feb. 1954, University of Florida.
2. K. Fischer, S. Blechman, and E. Lipstein, *Instruments* **14**, 65 (1941); V. P. Head, "Coefficients of float-type variable-area flowmeters," *Am. Soc. Mech. Engrs.*, advance paper for meeting, 29 Nov.–4 Dec. 1953.
3. W. A. Wildhack, *Rev. Sci. Instr.* **21**, 25 (1950).
4. A. S. Iberall, *J. Research Natl. Bur. Standards* **45**, 398 (1950).
5. Linear flowmeters are sold by National Instrument Laboratories, Riverdale, Md.
6. W. B. Hess, R. C. Swengel, and S. K. Waldorf, *Am. Inst. Elec. Engrs.* Misc. Paper 50–214 (Aug. 1950).
7. H. P. Kalmus, *Rev. Sci. Inst.* **25**, 201 (Mar. 1954).
8. E. J. Williams, *Proc. Phys. Soc. London* **42**, 466 (1930).
9. A. Kolin, *J. Appl. Phys.* **15**, 150 (1944).
10. W. G. James, *Rev. Sci. Instr.* **22**, 989 (1951); *Instruments* **25**, 473 (1952). These articles contain many references.
11. Y. T. Li and S. Y. Lee, *Trans. Am. Soc. Mech. Engrs.* **75**, 835 (1953).
12. The unit is supplied commercially by Control Engineering Corp., Norwood, Mass.
13. The massometer is made by Wallace & Tiernan, Belleville, N.J.
14. J. O. Kirwan and L. E. Demler, *Am. Soc. Mech. Engrs.*, paper 53-IRD-9 (Sept. 1953).
15. V. A. Orlando and F. B. Jennings, *Am. Soc. Mech. Engrs.*, paper (July 1953), unpublished.
16. As supplied by the General Electric Co., West Lynn, Mass.
17. *U.S. Patent* 2,624,198.
18. Made by Control Engineering Corp., Norwood, Mass.
19. D. Brand and L. A. Ginsel, *Instruments* **24**, 331 (Mar. 1951).

Irradiation of Parts of Individual Cells II. Effects of an Ultraviolet Microbeam Focused on Parts of Chromosomes

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In about half of the dividing cells of our cultures of newt heart (*1*), one or more chromosomes tarry near the centrosome(s) during part of metakinesis and metaphase. For periods ranging up to 30 min at 22°C, these "centrophilic" chromosomes lie with their kinetochores presented to the centrosome(s), but they regularly migrate, kinetochore foremost, to the metaphase plate before anaphase. With phase-contrast microscopy, the kinetochore is clearly distinguishable as a constricted region (Fig. 1*A*).

With a proton microbeam (*1*), preliminary experiments indicated that irradiation of a chromosome segment containing the kinetochore resulted in the chromosome drifting about the cell instead of migrating straightway, kinetochore foremost, from the vicinity of the centrosome to the metaphase plate. We have investigated this effect further by means of a newly developed *ultraviolet* microbeam (*2*).

As early as 1912, Tschachotin (*3, 4*) obtained a microbeam by using refracting lenses to reduce the image of an ultraviolet source to microscopic dimensions, but the difficulties associated with aiming have limited the usefulness of his devices (*5*), especially for irradiation of very small regions in preparations as complex as tissue cultures. By using a *reflecting* objective and the principle of incident illumination, we have constructed a simple apparatus in which the same lens is used simultaneously for observation and for ultraviolet microbeam bombardment (Fig. 2).

The aiming and viewing portion of the device is a microscope with a reflecting objective. The magnifying system is fixed, focusing being accomplished by adjusting the height of the stage. The image of the target is brought into focus in the plane of a set of aiming cross hairs in the ocular. An adjustable telescope, focused on these cross hairs, permits compensation for variations in eyesight and, thus, insures that a target under observation can always be brought into focus at exactly the same point below the objective.

For ultraviolet bombardment, a quartz lens focuses

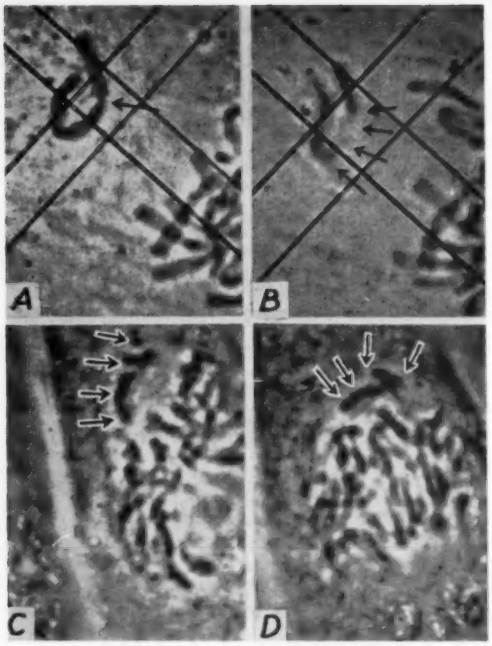

Fig. 1. Effect of irradiating a chromosome in the kinetochore region. (*A*) Before irradiation during metaphase (kinetochore at arrow). (*B*) Immediately after irradiation; irradiated segment "pale" (arrows). (*C*) Irradiated chromosome (arrows) drifting. (*D*) Anaphase. Irradiated chromosome (arrows) still drifting; never joins metaphase plate. (Phase-contrast microscopy. Prints from 16-mm motion-picture film. Each print represents an actual area 30 by 40 μ.)

the image of an ultraviolet source onto a small "primary" aperture. An appreciable fraction of the light passing this aperture is reflected by a partially aluminized glass plate onto the objective. A greatly reduced image of the primary aperture is thus formed below the objective. By adjusting the optical path length between primary aperture and reflecting objective, the microbeam is focused onto the same plane for which the viewing microscope is in focus.

The objective we are currently using (American Optical #1200, with quartz dust cover removed) contains only reflecting surfaces and, therefore, in the absence of any intervening refracting material, brings visible and ultraviolet light to a common focus. With our tissue cultures, the thickness of such material (a mica cover slip 5 μ thick plus a few microns of culture medium) introduces negligible chromatic aberration (*6*). Accordingly, the primary aperture is moved until visible light passing through it is brought into sharp focus on a mirror placed in the object focal plane. The primary aperture is then moved so that its microimage is centered on the aiming cross hairs. Aiming the ultraviolet microbeam is then accomplished merely by focusing the microscope on the target and centering the target image on the cross hairs.

Suitable baffles minimize stray radiation. By interchanging primary apertures, we have used microbeam focal spots of various shapes and dimensions. Diffraction patterns of the Airy type set a practical lower limit of about 1 or 2 μ for the shortest dimension (*7*).

For the present experiments, we used a circular primary aperture 400 μ in diameter, which, with an optical path length of 180 mm, yielded a microspot about 7 μ in diameter. A Hanovia high-pressure mercury arc was the source. Selective absorption in the mica cover slip, especially of the shorter wavelengths, considerably altered the energy spectrum of the ultraviolet microbeam from that of the source. Selection of targets was restricted to cell parts only a few microns below the culture cover slip, thus minimizing scattering and absorption as well as chromatic aberration.

The cultures of newt (*Triturus viridescens*) heart and the cinematographic methods of recording the results obtained with each cell were the same as those described previously (*1*). For each experiment, a mitosis was selected that had a "centrophilic" chromosome with a clearly visible kinetochore. After preirradiation photography at 15 frames/min, the culture was transferred to the bombardment apparatus (Fig. 2) and a linear segment of the chromosome was exposed to the ultraviolet microspot. The culture was then returned to the observation microscope, and pho-

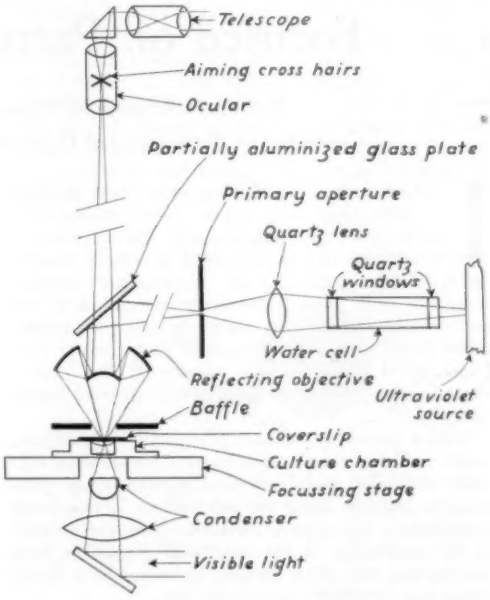

Fig. 2. Arrangement for irradiation with ultraviolet microbeam.

tography was resumed. Since the total length of the chromosome was 25 to 30 μ, the 7-μ microspot covered between one-third and one-fourth of its length.

Immediately after irradiation, the bombarded chromosome segment appeared "pale"; that is, its index of refraction was changed so that it no longer appeared blackish by medium-dark phase-contrast microscopy. This "paling" intensified for 20 or 30 min after irradiation and usually came to extend beyond the irradiated segment, so that frequently a considerable fraction of the irradiated chromosome appeared only as a colorless "ghost." Aside from its intrinsic interest, this phenomenon served as a valuable check on the accuracy of the aiming.

In each of 20 chromosomes (group A), the irradiated segment included the kinetochore; the exposure was 3 min. In 15 other chromosomes (group B), the kinetochore was excluded from the irradiated segment; 10 were exposed for 3 min, and the rest for 6 min. Without exception, those of group A failed to join the metaphase plate and drifted until anaphase (Fig. 1). After anaphase, each of these drifters was squeezed into one of the daughter cells by the constriction of the cytoplasm and formed either an accessory nucleus or a lobe on one of the main daughter nuclei. By contrast, all chromosomes of group B joined the metaphase plate before anaphase, even though some of them were exposed twice as long as group A. Moreover, this migration to the plate, in contrast with the drifting after kinetochore irradiation, was normally directed; that is the kinetochore proceeded foremost, with the two "legs" of the chromosome trailing behind.

This experiment shows that when parts of chromosomes are exposed to ultraviolet light, the normal directed movement of the chromosome from centrosome region to metaphase plate is inhibited only if the kinetochore is included in the irradiated part.

Work is in progress to improve visual observation during bombardment by equipping the apparatus with phase-contrast and dark-field illumination. This will permit the use of smaller microspots to determine how well the ultraviolet-sensitive entity corresponds to the morphological kinetochore. Work is also in progress to utilize monochromatic radiation and to measure the energy in the microbeam.

References and Notes

* National Science Foundation Fellow.

1. R. E. Zirkle and W. Bloom, *Science* **117**, 487 (1953).
2. This work was supported by grants from the U.S. Atomic Energy Commission, the Office of Naval Research, and the Abbott Research Fund of the University of Chicago. We are grateful for assistance from Theresa Panny and Robert P. Perry.
3. S. Tschachotin, *Biol. Zentr.* **32**, 623 (1912).
4. ———, in Abderhalden, *Handbuch der biologischen Arbeitsmethoden* **3** (Urban and Schwarzenberg, Berlin, 1938), p. 877.
5. Also see the discussions by H. J. Muller (U.S. Pat. No. 1458143) and by S. Zamenhof (*Rev. Sci. Inst.* **14**, 17, 1943). Tschachotin's technique was extensively used by F. Seidel [*Arch. Entwicklungsmech. Organ.* **132**, 671 (1935)] in experimental embryology.
6. In case the amount of refracting material is not negligible, it can be compensated by suitably adjusting the position of the primary aperture.
7. Details of the apparatus will be described and discussed elsewhere.

Rudolf Höber: His Life and Scientific Work

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PHYSIOLOGY lost another of its great leaders when, on 5 September 1953, in Philadelphia, Rudolf Höber passed away. It was my privilege to work with him years ago in the Kiel laboratory and to see him frequently after he came to America. More than any other man, he has been to me my master in science. He was a fine and true spirit of intelligence and human sympathy, who stimulated the scientific work of a great group of students and colleagues. Through his books and publications, he has had a truly international influence.

Höber was born in Stettin, Germany, on 27 December 1873. From early childhood he was devoted to natural science, spending much time in collecting plants and minerals and in microscopic studies. He early read Darwin and other biological classics. He decided to study medicine, not to practice, but to prepare himself for a life of teaching and research. He attended the Universities of Freiburg, Berlin, and Erlangen. In 1898 he graduated in medicine at Erlangen.

Soon after taking his medical degree, Höber joined the staff of the Physiological Institute of the University of Zürich, directed by J. Gaule. His first scientific paper, an experimental study of wound shock, appeared in 1898. During the next 10 years there followed more than 30 papers from his own pen. At the same time, 22 graduate students wrote their doctoral theses under his direction. Höber's interest ranged broadly over his field. His work included studies of intestinal resorption, the mechanism of catalysis, the permeability of cells, the hydroxyl ion concentration of the blood, the mechanism of narcosis and its influence upon permeability, vital staining, the secretion of the urine, the physiological significance of the colloids, and the effects of ions upon the resting potential of nerve and muscle.

During this period, Höber's basic scientific interest

became fully defined. He wished to understand the nature of the cell membrane, its physicochemical structure and composition, its electric properties, its ability to permit or prevent the movement of material into the cell, its change in permeability during excitation. To this end, he devoted much study to Overton's theory of lipoid solubility (1895) as an explanation for the differing penetrations of various organic substances into cells. He pointed out exceptions to the rule, while supporting the idea with many new experimental demonstrations. He was also intensely interested in Bernstein's "membrane hypothesis" (1902), which explained the electromotive forces of living tissues as due to a selective ion permeability in the membranes combined with ionic gradients across them, particularly of the potassium ion. He brought extensive experimental support to this conception, and his name is sometimes linked with Bernstein in describing the hypothesis. He lived to see hypothesis grow to theory and then to generally recognized fact. At the end of his life, he was delighted to follow the modern forms of the theory, such as have been presented by Hodgkin and Huxley, Curtis and Cole, and other recent investigators. While recognizing the validity of Overton's views for the penetration of organic nonelectrolytes, he strongly insisted upon the necessity for a complementary "pore theory" to explain many of the known facts of permeability, particularly for ions.

Höber's crowning achievement while at Zürich was the production of his monograph entitled, *Physikalische Chemie der Zelle und der Gewebe*. The first edition, in 1902, was a thin volume of 300 pages. The book went through seven editions, growing finally to 900 pages in the 1926 issue. This work established his reputation as an international authority in the field that is often called "general physiology." Although widely consulted in Britain and America, it was never translated into English. It antedated by 13 years the first edition of *Principles of General Physiology*, published in England in 1915 by Sir William M. Bayliss. Somewhat similar in scope and manner of treatment these two monographs have had a great influence in extending basic studies in physiology.

It is interesting to note that the determination to write a monograph came to Höber while he was still a student at Erlangen. His uncle, Isadore Rosenthal, was professor of physiology there. Rosenthal put into his hands Nernst's *Lehrbuch für Physikalische Chemie*. The idea then grew in his mind that he must attempt to apply physicochemical principles to living cells. He established contact with Nernst and had his help in devising apparatus. He was also influenced by the writings of Claude Bernard, Virchow, Ehrlich, and Helmholtz. He greatly admired the work of Jacques Loeb and maintained correspondence with him.

In all of his scientific interests, Höber was ably assisted by his devoted wife, Josephine, neé Marx, who completed the study of medicine after their marriage in 1901. She was one of the first women physicians in Germany. She not only directed his household and raised their son, Johannes, and two daughters, Gabriele and Ursula, but carried on a medical practice at the same time that she collaborated in some of his experiments.

In 1909 Höber left Zürich to go to the Institute of Physiology in Kiel, directed by Hensen, codiscoverer of glycogen. His old boyhood friend, Albrecht Bethe, shortly succeeded Hensen, and Höber was advanced to a full professorship in 1912. He followed Bethe as director in 1915, when the latter was called to Frankfort. In spite of increasing administrative responsibilities, his scientific productivity continued. His laboratory became a rendezvous for a long succession of graduate students and younger colleagues. Many came from Japan, Russia, Scandinavia, and America in addition to the more numerous groups from Germany, Austria, and Switzerland. In his view they were his fellow-students, partners in a research team. He was accessible to all, democratic in attitude, generous with aid and counsel, always interested in their problems.

In his work with medical students Höber was an outstanding teacher, speaking clearly and simply, with a lively sense of humor, much beloved by them. For their instruction he produced, in 1919, the first edition of his *Lehrbuch der Physiologie des Menschen*, which went through eight editions and became a popular textbook throughout Germany. It continued to be used long after he left Germany, the final edition being printed in Switzerland in 1939.

In 1918 Höber joined Abderhalden and Bethe to form the famous triumvirate that edited *Pflügers Archiv* over many years (1918–34). In it were reported many studies done in his laboratory. In a single decade (1924–33) we find there a series of 30 papers dealing with permeability studies done on perfused frog kidneys. Höber's interest was not primarily in the special physiology of the kidney. He used this organ, rather, as a means to attack more fundamental problems of general physiology. In the same spirit he perfused

other glands, such as the liver, studying the role of lipoid solubility, of molecular volume, and of electric charge in the penetration of various substances through the gland cell membranes.

In recollection of Höber's technical skill, we may mention his measurement of the internal electric conductivity of living cells (1910). With the aid of Walter Nernst, he modified the Wheatstone bridge by the introduction of condensers into two arms. At high frequencies of the oscillating current, cell suspensions introduced between the condenser plates caused increases in capacity that demonstrated a considerable internal conductivity. Höber concluded that a substantial fraction of the intracellular electrolytes are present in free solution, and not held in organic union, as had previously been believed.

Between 1925 and 1932 Höber served twice as dean of his medical school. In 1929, as president of the German Physiological Society, he paid his first visit to the United States, attending the XIII International Physiological Congress in Boston. After the congress he spent some time at the Marine Biological Laboratory at Woods Hole, a place to which he was later to return through many summers. As his final honor in Kiel, he served as rector of the University in 1930–31.

Although devoid of political connection and interest, Höber was forced at this time to oppose the rising tide of Nazism among the students. In the spring of 1931 a group of these students threw stench bombs into the church as the Reverend Otto Baumgarten, an outstanding Lutheran clergyman and pacifist and chaplain of the University, was conducting services. Fourteen Nazi students, caught by the police, were tried before a disciplinary court under Höber's chairmanship. Six were expelled from the University. There was general approval of the action, but Höber gained the bitter enmity of the Hitler group. Within a week after Hitler came to power, on 5 March 1933, Höber's laboratory was occupied by Nazi students. He was confined to his residence on the second floor of his Institute, with permission to go only to his study on the first floor. These restrictions were shortly lifted and he was able to resume lecturing at the beginning of the summer semester. His return to the lecture platform was greeted by an ovation from his students. But 4 months later, in September 1933, he was forced into retirement by the German Ministry of Education. Some vestige of German honor still moved the Nazi officials, for his pension was regularly paid until the time of Pearl Harbor.

Höber's plight became quickly known in England, where the press carried the story. He immediately received an invitation from the University of London. Leaving Germany at the end of September 1933, he worked for a few months with A. V. Hill, at University College. In the Spring of 1934 he received an invitation to join the staff of the Department of Physiology, School of Medicine, University of Pennsylvania, in association with H. C. Bazett and M. H. Jacobs. He and his wife soon reached America, accompanied by their daughter, Ursula, who continued her medical education at Pennsylvania, graduating in 1937. During the next few years Höber was able to assist the emigration to America of his son, Johannes, and his daughter, Gabriele, with their families. The time of stress and strain was finally over. In his last years he was happy in his circle of seven grandchildren.

In Philadelphia the Höbers created a new home and a new scientific life. Höber was able to resume his beloved teaching and research, with assistants financed by special grants. During the next 14 years he published 30 more papers, mostly in collaboration. In 1945, with David Hitchcock, John Bateman, David Goddard, and Wallace Fenn, he issued a symposium volume with the same title as that of his famous German monograph, *Physical Chemistry of Cells and Tissues* (Blakiston). He dedicated it to his wife "who inspired and encouraged me to create a renaissance of my previous book, and passed away too early to see it come to life." He here brought together his final summary of the various factors that determine the penetration of substances into cells and of the chemistry and physics of the plasma membrane. His basic faith in the importance of such analysis had never wavered, during half a century. He stated his conviction in the preface to this volume, as follows.

> It is not only possible, but of importance, to anchor physiology even deeper in physical chemistry than was done previously, *i.e.*, even closer to the fundamentals, on which our concepts of inorganic nature are erected . . . when one tries to segregate the elementary processes combined in the life of a cell and to analyze them with the new tools of modern physics, this attitude makes more discernible the great number of unsolved problems.

Soon after he reached America, I invited Höber to join the staff of the summer course in physiology at the Marine Biological Laboratory. He accepted at once and joined us with great interest and enthusiasm. His initial difficulties with spoken English could never mask his intense devotion to his scientific field and his mastery of it. He was soon speaking fluently, and his lecture hall was always crowded. He spent long hours with our students and was interested in every experiment that they did, recapturing in the new land his zeal for teaching. After the course his own experiments, with his wife's help, went actively forward. He was a veritable dynamo of intellectual power. He came back to Woods Hole last in 1949, at the age of 76, weakened in body and in mind by the passage of the years, but still eagerly attending the physiology lectures and engaging in scientific discussions.

Höber never returned to Germany, although he was often invited to do so. I went back to Kiel in 1947 and revisited the shattered city. The old laboratory is now a ruin, blasted by bombs that left only remnants of the walls. The basic science departments of the medical school of the University of Kiel have moved to new quarters. There a new Institute of Physiology has been created, named the "Rudolf Höber Haus," to perpetuate through the years the memory of the inspired teacher and investigator whose devotion gave us new insights into physiological function.

News and Notes

Recent Advances in Astronomy

Features of the 91st meeting of the American Astronomical Society held at the University of Michigan, 20–23 June, included a symposium on turbulence and magnetic fields in the photosphere of the sun; the first joint session with the Association for Computing Machinery; and a lecture on the spectrum of the aurora and airglow, delivered by A. B. Meinel, associate director of Yerkes Observatory, in connection with his receiving the Helen B. Warner prize for astronomy. About 200 astronomers were in attendance and more than 70 papers were presented. Donald H. Menzel, director of Harvard College Observatory, was elected president for a 2-yr term.

During the symposium H. W. Babcock reported on the work that he and his father, H. D. Babcock, have been doing at Mount Wilson and Palomar observatories with a solar magnetograph—an instrument utilizing the Zeeman effect for automatically scanning the sun and recording weak magnetic fields down to a fraction of a gauss. Fine structure, with local fluctuations in time in all surface fields, suggests a close connection with turbulent elements on the sun's surface. Besides the well-known bipolar magnetic regions on the sun, the Babcocks found a few unit-pole regions which they suggest might be identified with corpuscular streams producing magnetic storms on the earth at 27-day intervals as the sun rotates. A 27-day period in cosmic ray intensity might also be a result of these fields.

In his symposium paper Martin Schwartzschild of Princeton proposed using high-altitude balloons, carrying a special telescope, for photographing the sun's surface. Above most of the earth's atmosphere he expects that photographs will reveal features as small as 300 km in diameter. Statistical methods developed by aerodynamicists for handling turbulence phenomena indicate that the most energetic eddies on the sun's surface involve features smaller than the 1000-km ones which can be observed from the surface of the earth.

S. Chandrasekhar of Yerkes Observatory closed the symposium with a discussion of the influence of Coriolis acceleration and magnetic fields in impairing convection. As he pointed out, progress on this very complicated problem is slow.

The use of rockets at heights up to 128 km for absolute-intensity measures of the Lyman-alpha region of the sun's spectrum was described by Leo Goldberg of the University of Michigan. Photon counters telemetered observations to the ground. Measurements were consistent with a model of the chromosphere in which the temperature is constant from the base of the chromosphere to an altitude of 4000 km and then increases to about 6000°K at 6000 km. A temperature of about 4600°K is indicated for the low chromosphere.

On the basis that the width of the helium line at 10,830 A is due to thermal effects, University of Michigan investigators at the McMath-Hulburt Observatory derived a temperature of 48,000° for the high region of the chromosphere that is the source of this radiation.

Studies of the intensities of 196 solar flares by McMath-Hulburt astronomers showed a close correlation between the intensity of flares and the occurrence of sudden ionospheric disturbances. Disturbances were rare at the time of low-intensity flares, but disturbances always occurred during flares of the highest intensity. Leif Owren of the Carnegie Institution of Washington and Miss Dodson of McMath-Hulburt Observatory presented a paper showing the association between flares and the onset of "noise storms" at 200 Mc/sec, as recorded by the radio telescope at Cornell University; a flare is associated with every case of a definite onset of a noise storm.

J. C. Pecker and W. O. Roberts of Harvard's High Altitude Observatory, Climax, Colo., reported that geomagnetic disturbances on the earth are smallest 3 days after the passage of an active region across the central meridian of the sun. Two or 3 days before and after this minimum of activity, there are maximums of activity that are postulated as due to corpuscular streams from the sun deflected from the active area by magnetic fields. Daily observations of the solar corona may be of great value in predicting times of geomagnetic storms. This observatory also reported the observation of a speed of 150 km/sec in the corona. This is the only clear-cut evidence of large-scale motion in the corona.

Constance S. Warwick of the Upper Air Research Observatory at Sacramento Peak, N.M., reported on heights of solar flares in connection with sudden ionospheric disturbances. Flares lower than 15,000 km have practically no associated disturbances, but above this height one-half of the flares cause disturbances. Lyman-gamma, -beta, and -alpha radiations were suggested as a possible source of the disturbances.

The identification of the coronal yellow line at 5694 A as due to calcium XV was questioned by Harold Zirin of Harvard from his computations of theoretical spin-orbit constants for p^2 configurations.

C. Y. Fan of Yerkes Observatory told how different types of auroras show different spectra. Auroral arcs produce intense hydrogen-alpha emission, whereas auroral rays show no Balmer lines of appreciable intensity. The spectrum of the auroral arc indicates that protons are impinging on the earth's atmosphere.

Investigations at Perkins Observatory on scintillation of starlight indicated that the elements producing the scintillation are 2 to 4 in. wide and up to 1.5 ft long. They move in the direction of elongation, a direction corresponding to that of winds at 10,000 ft. To avoid some of the disturbing effects of the atmosphere close to instruments, McMath-Hulburt astronomers now have a spectrograph tube 52 ft long and 4 ft in diameter from which the air can be evacuated. This is

expected to increase the resolving power of the spectrograph from 200,000 to 500,000.

Reports in the field of radio astronomy emphasized the rapid advances that are being made. At the Agassiz Station of the Harvard Observatory, Bart J. Bok and his assistants operate a 24-ft parabolic antenna in conjunction with a comparison radiometer to record profiles of the 21-cm line of neutral hydrogen. A study of the Taurus dark nebula complex reveals a correlation between the hydrogen gas and the obscuring dust in this region. Where major areas of dust exist, a strong increase in the hydrogen radio emission occurs. An investigation of the 21-cm line in the direction of the galactic center shows profiles with double peaks, suggesting either two distinct regions of hydrogen with a radial velocity difference of 10 km/sec or a "cold" region in front of a "hot" region producing an absorption effect. This cold region might be the space between the galactic spiral arm in which the sun is located and the next arm toward the galactic center.

The U.S. Naval Research Laboratory reported the discovery of radio waves from the Orion nebula and a dozen other areas at wavelength 9.4 cm. For the first time, seven other sources were reported at wavelength 21 cm. J. D. Kraus and H. C. Ko described the Ohio State University radio telescope and the great detail that is shown in its picture of the sky as seen by radio waves; 207 radio sources have been found, and the position of the center of the galaxy was given to a hundredth of a degree.

The application of television techniques to astronomy was discussed by W. A. Baum of Mount Wilson and Palomar observatories. He pointed out the limitations of direct photography with the Palomar 200-in. telescope. A 30-min exposure on an Eastman 103aO plate shows a star of magnitude 23.8. Further exposure may result in a poorer plate. Photoelectric techniques should produce results that might be expected from a 2000-in. telescope at $f/3.2$. A cooperative investigation into the transfer of photoelectrically liberated charges into photographic grains is under way. Harold L. Johnson of Lowell Observatory described an electronic integrator-type direct-current amplifier that makes possible a comparison of the radiation from bright stars with that from extremely faint stars.

Photoelectric observations of the occultations of the stars by the moon, reported by George W. Preston and Soren W. Henricksen of the Army Map Service, showed several cases of a double drop in light intensity as the star disappears behind the moon, indicating that the star may be double. The possibility of observing diameters of very large stars by this effect was suggested.

At Swarthmore, careful determinations of the masses of components of a dozen visual binaries confirmed the existence of underluminous and overluminous stars, an effect pointing toward differences in the relative abundance of elements in stars.

The variable star AG Pegasi, found to possess a magnetic field by Horace W. Babcock, was reported by University of Michigan observers Gordon Grant and L. H. Aller to have shown a continuous rise in excitation over the last few years. John S. Hall of the U.S. Naval Observatory reported on polarization observations of the light of stars in the Pleiades, 22 deg below the galactic plane. Polarization of the light was found and it indicated that clouds of dust connected with stars produce polarization as interstellar matter does. As the result of work done with the 200-in. Palomar telescope, Jesse L. Greenstein announced the discovery of clouds of gas (shells) around the supposedly nearly "dead" white dwarf stars.

Classification and distribution of M-type stars from Schmidt objective prism plates was discussed by observers of the Warner and Swasey Observatory. M-stars beyond the center of the galaxy were studied.

A. Blaauw of Yerkes Observatory investigated seven nearby associations of stars by means of the space velocities of the stars with respect to the centers of the associations. He found a difference in velocities for single and double stars. All fast-moving stars are single stars.

The problem of the chemistry of interstellar grains was emphasized by Bertram Donn of Wayne University. He said that the only way to proceed is to conduct experiments under conditions that are as near to interstellar conditions as possible. At present no work has been done at temperatures below 77°K, whereas interstellar grains have temperatures of perhaps 50°K.. Now that it is possible to obtain low temperatures, astronomers can seek the help of physical chemists in this field.

The new Super-Schmidt cameras, designed by J. G. Baker for photographing meteors, have made possible the discovery that faint meteors decelerate in the atmosphere much more rapidly than do bright meteors. This phenomenon, together with other phenomena, has led Luigi G. Jacchia of Harvard to postulate the complete breaking up of small meteors into fragments as soon as they encounter sufficient atmosphere to make them luminous.

As the result of work done largely with the 200-in. telescope, Milton L. Humason and Hugo D. Wahlquist of Mount Wilson and Palomar observatories reported a determination of solar motion with respect to 13 members of the local group of galaxies. The speed of the solar system is 292 km/sec.

A. D. Code and T. E. Houck of the University of Wisconsin showed evidence of spiral arms in the galaxy from wide-angle photographs of the Milky Way taken at Bloemfontein, South Africa. Points of cutoffs in the surface brightness of the Milky Way agree with the assumption that our galaxy is a spiral of type Sb.

The joint session with the Association for Computing Machinery was presided over by John Mauchly of Remington Rand. Four papers were presented by astronomers illustrating the kind of work that can be done with electronic calculators. Marshal H. Wrubel of Indiana University spoke on the problem of stellar evolution. Jean K. McDonald told of her application

of machines to the problem of models of stellar atmospheres. Ralph E. Williamson of Los Alamos reported on the stupendous possibilities of the machines for problems in stellar dynamics. He considered the evolution of a two-dimensional cluster of 100 stars under their mutual gravitations. Ten million years in the life of the stars occupied 1 min of computing time. In the course of the evolution of the cluster, some stars became lost to the cluster and some double stars and some multiple stars were formed. John K. Wilkinson and Lawrence H. Aller of the University of Michigan reported on some applications of punched-card techniques; 10,000 wavelengths in rotation-vibration band spectra were computed, making practical a study that otherwise might not have been attempted. The astronomers made some suggestions as to what they would like to have included in calculators, but expressed general satisfaction with the present machines.

N. E. WAGMAN
Allegheny Observatory, University of Pittsburgh

Philippine Science

The third annual meeting of the Philippine Association for the Advancement of Science took place in Manila, 3–5 December 1953, under the presidency of Juan S. Salcedo, Jr. This organization—which held its first annual meeting in 1951, the year it was formed—has a membership of 138. There are five divisions: Agricultural Sciences; Anthropology and Archeology; Biological Sciences; Chemistry; Physics and Mathematics; and Geography and Geology.

Each section presented a half-day symposium. These were scheduled in sequence, not concurrently, so that it was possible for one person to attend every session if he wished—in welcome contrast to most scientific meetings. There were no sessions for contributed papers; but there was much discussion from the floor. This was encouraged by the appointment of specific individuals to comment on each paper, thus stimulating general and animated participation.

The registrants included 79 members and 134 guests, a highly creditable showing in two distinct ways: more than half of the membership attended, and the number of persons attending because of general interest considerably exceeded the number of members present. Scientific organizations in other parts of the world will find it difficult to duplicate this record.

At the concluding evening dinner session, awards of merit were granted as follows: *Entomology,* Leopoldo B. Uichanco, dean of the College of Agriculture, University of the Philippines, Laguna; *Pharmaceutical chemistry,* Patrocinio Valenzuela, dean of the College of Pharmacy, University of the Philippines, Diliman, Quezon City; *Anthropology,* H. O. Beyer, head, department of anthropology, Museum and Institute of Anthropology and Ethnology, University of the Philippines, Diliman, Quezon City.

Joaquin Marañon, director of the Institute of Science and Technology, Manila, was elected president of the Association for the present year. Ramon Samaniego of the Bureau of Soil Conservation, Manila, continues as secretary.

R. C. MILLER
California Academy of Sciences, San Francisco, California

Science News

In a paper scheduled to appear soon in *Science,* Kiku Nakao, Louis Plzak, and William Bethard describe the use of radioactive iron at the Argonne Cancer Research Hospital in Chicago to study the *in vitro* **synthesis of hemoglobin in erythrocytes** of pigeons. The information obtained from these experiments suggests that the mechanism operative in the formation of the oxygen-carrying red pigment *in vitro* may be different from the one operative *in vivo.*

That better jet fuels can result from a study of chemical reactions taking place high in the atmosphere has been pointed out by Joseph Kaplan, professor of physics at the University of California, Los Angeles. These reactions produce "airglow," which has been found to be "intimately connected" with the **chemistry of jet fuels.** Information on the various combinations of oxygen and nitrogen needed for laboratory studies, he said, "can be gotten from experiments made for us by nature" several miles overhead. Dr. Kaplan gave this information to the House Committee on Appropriations while justifying appropriations for the International Geophysical Year, scheduled for 1957–58. The National Science Foundation has requested a supplemental appropriation of $2½ million for fiscal year 1955 to finance the U.S. program for IGY.

John Franklin Carlson, 54, professor of physics at Iowa State College, died in Ames, Iowa, on 5 Apr. A gifted scholar and teacher, he was educated at the University of California where he received the doctoral degree in 1932. After 1 yr as a research associate at California, he spent 3 yr at the Institute for Advanced Study at Princeton. During this period he and J. Robert Oppenheimer published a paper that laid the foundation for extensive theoretical research on cosmic ray showers.

In 1937 Dr. Carlson went to Purdue University, where he remained until 1942 when he was called to the Radiation Laboratory at Massachusetts Institute of Technology. He went to Iowa State in 1946 and 2 yr later became professor of physics and senior physicist with the Ames Laboratory of the Atomic Energy Commission. He taught in the fields of vibration and sound and quantum theory.

As a tribute to the inspiration and assistance he gave to those with whom he taught and worked, his friends and colleagues have established a fund in his honor to bring to Iowa State each year an outstanding

scholar who will deliver the John Franklin Carlson Lecture on some aspect of physical science, its philosophical implications and its relation to human affairs.

Perfectly **petrified insects**, spiders, and mites that lived 25 million yr ago during the Miocene period have been discovered by U.S. Geological Survey workers. The ancient creatures are being recovered by the dozens from nut-sized nodules of limestone taken from lake bottom deposits under the Mohave Desert. The nodules are dissolved in formic acid, which reveals the perfectly preserved fossils. They look as if they were cast in milk glass, because they have been turned into silica by a natural process that is not yet understood. This find, first made by Allen Bassett of the Geological Survey and considered a major event in entomological history, is discussed in more detail in this issue of *Science*, page 228, by A. R. Palmer and Dr. Bassett.

John W. Coulter, professor of geography at the University of Cincinnati, has begun a study of **population problems** on the island of Pinglap in the Eastern Carolines. Pinglap is believed to be one of the most overpopulated areas in the Pacific with 650 people living on two-thirds of a square mile of land. The atoll was selected as a "pilot" island in an attempt to find measures to solve or alleviate the overpopulation throughout the Pacific islands. Dr. Coulter is making the survey for the U.S. Trust Territory of the Pacific Islands Administration, the U.S. Navy, and the Pacific Science Board of the National Research Council.

This summer for the first time, a convoy of Canadian vessels will deliver supplies for the joint **Canadian-United States Arctic weather stations** in the Queen Elizabeth Islands, with the exception of the most northerly one, Alert. In referring to the supply project, the Minister of Transport said that "we hope to take in supplies for Alert Bay in 1955." Heretofore, the U.S. has furnished the ships to carry out the annual mission.

Australia's well-known **Lake Eyre**, ordinarily a vast dry desert, for the first time within living memory is filled with water and teeming with fish. Scientists who visited the lake in former years said it would never be full of water again and that fish could not live there because the water would be too salty.

Approximately 2000 Americans are believed to have been affected by a **snail-carried disease**, schistosomiasis, or katayama disease, during World War II and never treated. About 1500 cases were diagnosed and treated during the Leyte campaign and it was also prevalent among prisoners-of-war in the Philippines. The disease, which attacks man through free-swimming larvae developed in snails, results in thickening of the intestinal wall, cirrhosis of the liver, and urinary bladder disease.

John L. Wolford and John M. Rumball reported in the 17 July issue of the *Journal of the American Medical Association* on one case recently discovered in a former Japanese prisoner-of-war. They point out the difficulty of diagnosis and the importance of looking for the disease in similar instances, since early treatment can prevent further damage.

Development of a **method of growing yeast** that improves its value as a supplement to food and fodder through greater production of the amino acid methionine has been announced by J. S. Chiao and W. H. Peterson, University of Wisconsin biochemists. They grew 20 different species of yeast on various types of media and found that six species could be made to produce greater quantities of methionine by increasing the amount of nitrogen salts available to them. Production of methionine also is greatly increased if another amino acid, cystine, is added to the media. Yeast is widely used as a supplement in poultry feed and is one of the substances now under study as a possible aid in feeding the undernourished peoples of the world.

University of Illinois engineers have found that high-silicon steel rails, of little or no more cost than standard carbon steel rails, may be the solution to a new **rail wear problem** due to the modern, heavy diesel locomotive. In laboratory tests, silicon rails stood up twice as long as those of standard carbon steel. Some are now being service-tested on railroads.

As many as six **whooping cranes**, including young, have been seen in Canada's Wood Buffalo National Park. The world population of this crane is only 24. They are known to nest in Texas but their summer nesting ground is a long-standing mystery.

A new voluntary health association, **the National Foundation for Muscular Dystrophy, Inc.**, has been established with headquarters in the Fisk Building, 250 West 57 St., New York 19. It is dedicated to the sponsorship of research in muscular dystrophy and to the total care of the dystrophy patient. Officers are pres., Paul G. DeMuro, Passaic, N. J.; chairman of the Board of Directors, David L. Wilkoff, Pittsburgh; and chairman of the Medical Advisory Board, Charles A. Janeway, Boston.

The foundation is sponsoring research in orthopedics, neurology, pathology, and basic chemistry at the Children's Medical Center, as well as in investigatory study at the New York State Rehabilitation Hospital, West Haverstraw, N.Y., in cooperation with the New York state and city departments of health.

A 210,000-acre area has been set aside by the Venezuelan Government as the **Henry Pittier National Park** for the benefit of naturalists and other scientific investigators. Swiss-born Henry Pittier, a former U.S. Department of Agriculture scientist, spent the last 37 yr of his life in Venezuela and became one of its greatest scientists; he died in 1950.

The area includes a verdant forest on top of the Andes, thick jungle on the slopes, and wasteland on the plains near the sea, and part of large fresh-water Lake Valencia. The jungle area, known as the

"shrouded forest" because of the strange white mist that rises from the moisture-soaked earth, has no human inhabitants but is rich in wild life.

S. Dillion Ripley, II, assistant professor of zoology and associate curator of Yale's Peabody Museum, hopes that his present six-month trip to Indonesia may solve the problem of what happens when two similar bird groups are brought together for the first time. Over an extended period of time the Asian bird fauna has gradually moved into the many Indonesian islands, while the fauna from the Australian continent has moved northward into the same islands. He believes that on the island of Halmahera, midway between Dutch New Guinea and the Philippines and on the "meeting line" of the faunas, he may be able to observe the **natural process of evolution** as it involves the two bird groups. The expedition will be financed by a Guggenheim fellowship and a grant from the National Science Foundation. The *National Geographic Magazine* will furnish photographic equipment.

The cause of strange "false" fractures, so-called pseudofractures, that occur in osteomalacia, a disease marked by softening of the bone, apparently has been found by physicians at the University of California School of Medicine. In x-ray pictures the **pseudofractures** appear as dark bands on the outer layer of the bone. Many of them are present in almost symmetrical order on the shoulder blade, the ribs, and other bony structures. They give the appearance of fractures that have not completely healed.

Recently, Howard L. Steinbach, Felix O. Kolb, and Rutherford Gilfillan made detailed studies of a patient with osteomalacia who had many pseudofractures throughout the skeleton. They found the "false" fractures occurred where blood vessels pass adjacent to the bone. The pulsation of the vessels, they suggest, exerts sufficient pressure to cause erosion of the softened bone, thus producing the pseudofractures. . . . In the past they have been attributed to unusual muscular stress bringing pressure on the bones.

A memorial in Mackinac Island, Mich., has been dedicated to William Beaumont, who made the first important study of digestion of food in the stomach. The shrine to a classic research in medicine is a reconstruction of the retail store of the American Fur Co., where in 1882 Dr. Beaumont, an Army surgeon stationed at Fort Mackinac, was called to attend Alexis St. Martin who had been accidentally shot through the stomach. For a 2-yr-period Dr. Beaumont tried to heal the wound, but without success. It was them that he started an 8-yr study of the physiology of digestion. He published his findings in 1833. The Michigan State Medical Society is sponsoring the **Beaumont Memorial.**

Robert P. Sharp, chairman of the division of geological sciences at the California Institute of Technology, is heading a seven-man summer expedition, sponsored by the Office of Naval Research for **glaciological research** at Saskatchewan Glacier in the Canadian Rockies and at Malaspina Glacier in Alaska. The chief project is to establish a bore hole approximately 1500 ft deep and extending from the surface to the bottom of the ice, near the upper reach of the Saskatchewan Glacier. The pipe used as a drill stem for the electrical drilling operation will be left in the hole so that its deformation may be measured from year to year.

An inclinometer reading of the bore hole established in 1951 near the center of Malaspina Glacier will be made. These investigations are aimed at determining whether the Malaspina Glacier, which rests on a comparatively flat surface, and the Saskatchewan Glacier, a mountain valley ice flow, experience the same mode of flow below the surface. Other members of the team include Samuel Epstein, Mark Meier, and Gunnar Bergman.

Scientists in the News

Willard Bascom, research engineer with the University of California's Scripps Institution of Oceanography, La Jolla, is on leave of absence for 1 yr to serve as executive director of the National Research Council's advisory committee on civil defense.

Five employes of the U.S. Department of Agriculture have received Distinguished Service awards for outstanding achievements in research.

Esther L. Batchelder, Human Nutrition Research Branch, Agricultural Research Service, Beltsville, Md., for research in food and nutrition and application of results to improved national and international utilization of food.

Richard T. Cotton, entomologist, Biological Sciences Branch, Agricultural Marketing Service, Manhattan, Kan., leadership in the field of control of insects attacking stored grains and cereal products.

George M. Darrow, horticulturist, Horticultural Corps Research Branch, Agricultural Research Service, Beltsville, Md., contributions to the breeding and improvement of small fruits.

Ralph A. Rusca cotton technologist, and **Ray C. Young,** mechanical engineer, Southern Utilization Research Branch, Agricultural Research Service, New Orleans, a new-type opening machine for lint cotton that permits economic processing of mechanically harvested cotton used in the manufacture of textiles.

John Biggs, Jr., chief judge of the U.S. Court of Appeals, Wilmington, Del., has been given the American Psychiatric Association's Isaac Ray award for notable contribution to the field of legal problems connected with mental disorders. He will deliver a series of 6 lectures on legal aspects of psychiatry in November and December at the University of California medical and law schools.

John O'M. Bockris, London, has been appointed professor of electrochemistry at the University of

Pennsylvania and **Donald C. Dittmer** will join the staff as an instructor in organic chemistry. Dr. Bockris served on the faculty of Imperial College before coming to the university as a visiting professor of chemistry last year. Dr. Dittmer has been a postdoctoral research fellow in Harvard University's department of chemistry.

The following are among those who have recently received **honorary doctoral degrees.**

University of Wisconsin: **Gregory Breit,** professor of physics, Yale University; **Earnest Albert Hooton,** professor of anthropology, Harvard University (posthumously); **Elvin Charles Stakman,** emeritus professor of plant pathology, University of Minnesota, and a past president of the AAAS.

University of Nebraska: **Jay W. Forrester,** director of the Digital Computer Laboratory, Massachusetts Institute of Technology.

Polytechnic Institute of Brooklyn: **Crawford H. Greenewalt,** president of E. I. du Pont de Nemours of Delaware.

Lorenzo L. Franceschini, Rome, is at Stanford Research Institute to study American methods of industrial research as the newest participant in SRI's industrial fellowship program. Former chief of the economics and labor section of Italy's National Productivity Committee, he will spend a year at the institute.

Alfred Gellhorn, director of the Institute of Cancer Research at Columbia University and chief of the Medical Service at the Francis Delafield Cancer Research Hospital in New York, and **Leopold Arnaud,** Columbia University School of Architecture, are spending 2 mo on a lecture tour in Brazil, Uruguay, Argentina, Chile, Peru, Colombia, and Venezuela under the International Educational Exchange Program.

Ben Hilbun was inaugurated in July as the 11th president of Mississippi State College.

The annual award of the Association for the Help of Retarded Children has been presented to **Leo Kanner** who established at Johns Hopkins Hospital the first children's psychiatric unit in connection with the pediatrics department.

Otto A. Krueger has been appointed manager of the International Harvester Co.'s industrial engineering and construction department, succeeding **J. R. Allan** who has retired. **Harold W. Parthemer,** construction engineering consultant, is now assistant manager.

Elizabeth T. Maguire, formerly of the United States Testing Co., Hoboken, N.J., has joined Lederle Laboratories as a chemist in the pharmaceutical control laboratory.

Monroe H. Martin, member of the University of Maryland faculty since 1933, has been appointed director of the university's Institute for Fluid Dynamics and Applied Mathematics. He was head of the mathematics department from 1943 until 1952 when he became acting director of the institute.

Thomas D. Moore is retiring as head of the department of urology at the University of Tennessee College of Medicine but will continue as professor of urology. Dr. Moore is now serving as president of the American Urological Research Foundation and is a past president of the American Urological Association.

On 27 Aug. **S. Ralph Powers,** professor emeritus of Teachers College, Columbia University, will sail with his wife for Cairo, where he will be a guest professor in the teaching of science at the Abbassia Men's Teacher Training College under a Fulbright award. He was expressly invited to this post by the dean of the college and the Egyptian Minister of Education. Dr. and Mrs. Powers will return to their home in Haworth, N.J., in June 1955.

Charles C. Price, former professor and head of the department of chemistry at the University of Notre Dame, has been named Blanchard professor of chemistry and director of the Harrison Laboratory of Chemistry at the University of Pennsylvania. The posts were held formerly by **Hiram S. Lukens,** who retired last year.

William E. Rand will terminate as director of physical sciences research at Stanford Research Institute in August to become a vice president of Newhall Land and Farming Co. An engineering graduate of the Massachusetts Institute of Technology, Mr. Rand will direct a future development program for the company.

Work has been started around Ica in the southern part of Peru by the fourth archeological team sent to that country by the University of California since 1899. In charge is **John H. Rowe,** associate professor of anthropology and assistant curator of South American archeology in the institution's Museum of Anthropology.

Harry C. Schmeisser has retired after 33 yr as professor of pathology at the University of Tennessee Medical Units and attendant to John Gaston Hospital. He will be appointed professor emeritus of pathology and consultant to city hospitals in Memphis. He joined the university staff in 1921.

Patrick W. Skehan, professor of Semitic and Egyptian languages at the Catholic University of America, will spend 1954–55 in Jerusalem, where he will do research work at the Palestine Archeological Museum and serve as annual professor of the School of Oriental Research.

George S. Smith has been made a vice president of the Johns-Manville Products Corp. and director of engineering for the Johns-Manville Corp., the parent concern. He joined the company in 1929.

Edward H. Spicer, professor of anthropology at the University of Arizona, has joined the staff of Stanford Research Institute for a summer of research at the San Carlos Apache Indian reservation 100 mi east of Phoenix. The results of his studies will be added to the work of the SRI team already investigating the economic problems faced by the Indians. The team includes a sociologist, geologist, agriculturist, forestry expert, and economists.

Two international honors have been awarded **Edward J. Squire,** head of Brooklyn Polytechnic Institute's department of civil engineering: the Order of Scientific Merit of the Humanist Institute of France, and Knight Commander with Star of the Order of the Gold Cross of the Military Chapter of Cyprus and Jerusalem. The latter order, with headquarters in Rome, is an independent laymen's order that was prominent in the early Medieval period and has been revived.

Arthur L. Tatum, 70-yr-old professor and chairman of the department of pharmacology at the University of Wisconsin, will retire this year after 26 yr of service with the university. He graduated from Penn College, Oskaloosa, Iowa, with a B.S. degree and earned his M.S. at the University of Iowa. In 1913 he received his Ph.D. from the University of Chicago and the following year graduated in medicine from Rush Medical College. He has served on the faculties of the universities of Colorado, Pennsylvania, South Dakota, and Chicago.

More than 175 publications bear witness to his research on malfunction of the thyroid gland, hypnotic drugs, and chemotherapy. In 1942 he was awarded the Charles Mickle fellowship by the University of Toronto and in 1948 the degree of doctor honoris causa by Peru's Greater National University of San Marcos of Lima. The next year he was made an honorary member of the Society of Biology of Montevideo.

Meetings

Significant among the sessions to be held at the 37th annual meeting of the **American Dietetic Association** will be those concerning the most recent trends in the field of nutrition. The meeting is scheduled for 26–29 Oct. at the Philadelphia Commercial Museum, Philadelphia. Frederick J. Stare of the Harvard Schools of Medicine and Public Health will open the session, "Nutrition advances," on 26 Oct. With him will appear Margaret Mead of the American Museum of Natural History, New York, and David M. Hegsted of the Harvard School of Public Health.

During a session devoted to "Nutrition in the world," August R. Lindt, a native of Switzerland who is chairman of the executive board of the United Nations Childrens Fund, will discuss the nutrition of children of many lands. Andromache Sismanidis, nutrition representative of the F.A.O., will draw upon her extensive travels in other countries to discuss their food habits. Elda Robb of Simmons College will describe her experience in establishing, last year, a college of nutrition and home economics in Jerusalem.

Charles Glen King of the Nutrition Foundation, Inc., New York, and Margaret A. Ohlson of Michigan State College will participate in the session, "Nutrition research."

Leonard A. Maynard of Cornell University will speak on nutritive additives during the session on "Nutrition fronts." Appearing with him will be Olaf Mickelsen of the National Institutes of Health, who will speak on "Nutrition and alcoholism."

The field of diet therapy will receive attention from Herbert Pollack, Mt. Sinai Hospital in New York, who will discuss adequate therapeutic diets; Paul Gyorgy, Hospital of the University of Pennsylvania, Philadelphia, who will speak on trends in infant feeding; Harold E. Harrison, Baltimore City Hospital, who will discuss vitamin D and calcium metabolism in children; and Mark A. Hayes, Yale University School of Medicine, who will present a paper on "A re-evaluation of nutritional requirements during complicated convalescence."

The New York section of the **American Institute of Chemical Engineers** will conduct a symposium 13 Oct. at the Hotel Statler, New York. Concurrent sections will be devoted to the topics "New developments in the petroleum and chemical industries" and "Cost estimations." More than 500 chemical engineers, executives, and students from the eastern part of the U.S. are expected to attend.

Some 140 scientists from 15 countries assembled at Lund, South Sweden, 1–5 July for an international **congress on spectroscopy.** Special honor was paid to the memory of J. R. Rydberg, whose pioneering work on spectral analysis largely formed the basis for modern achievements in the field.

Analyzing the flavor of foods and beverages, constructing buildings with plastics, and measuring the harmful effect of air pollution on plants and animals will be among the topics covered in more than 1300 scientific papers to be presented at the 126th **national meeting of the American Chemical Society** in New York 12–17 Sept. Some 12,000 chemists and chemical engineers from all parts of the United States and many foreign countries will attend the meeting and take part in the technical sessions sponsored by the Society's 21 scientific and technical divisions.

W. Albert Noyes, Jr., former president of the Society and chairman of the department of chemistry in the University of Rochester, will receive the Priestley medal at a general assembly 13 Sept. "Thirty years of photochemistry" will be the title of his address. Harry L. Fisher, Los Angeles, will present his presidential address, "The challenge of the American Chemical Society," at that time.

The **Pacific Slope Biochemical Conference,** an annual conference of biochemists from institutions of the

Pacific Slope states, will meet with the AAAS in Berkeley within the period 26–31 Dec. for the presentation of research progress reports. A dinner will take place on the evening of the day of the meeting.

A 1-day program will be held with concurrent sessions if the number of papers submitted make this necessary. Titles of papers should be submitted to the chairman, David M. Greenberg, Department of Physiological Chemistry, University of Californin, Berkeley, *not later than 1 Oct.*

In June the Middle-East Science Co-operation Office, with the assistance of the Lebanese Society of the Friends of Trees, held a symposium in Beirut on the **"Protection and conservation of nature in the Near East."** More than 50 zoologists, botanists, ecologists, foresters, geologists, soil scientists, and educators from Middle Eastern and Western countries met to exchange views and results of their work. In addition to study groups on fauna, flora, soil, and education, four plenary sessions were devoted to general topics.

The **Society for the Study of Human Work,** established in Nürnberg last year, held its first congress in March. The two principal themes were (i) the present status and impending tasks of the disciplines concerned with human work and (ii) man's readiness to perform. The disciplines represented in the society are physiology, psychology, education, sociology, and engineering. The society will utilize the *Zentralblatt für Arbeitswissenschaft und soziale Betriebspraxis* as its house organ.

Physicians and research scientists from more than 40 countries will attend the 2d **World Congress of Cardiology** that will convene in Washington, D.C., 12–17 Sept., jointly with the 27th **Scientific Sessions of the American Heart Association.** It will be the largest and most important cardiovascular meeting ever held in the Western Hemisphere.

The scientific program—in English, French, and Spanish—will be held at the National Guard Armory, where translation facilities will be provided for symposiums, panel discussions, and special features. In addition, over 250 papers will be presented during the formal scientific sessions to be held simultaneously in separate rooms. The discussions and reports will cover such subjects as coronary heart disease, rheumatic fever, hypertension, blood volume, heart surgery, congenital heart disease, electrocardiography and ballistocardiography, atherosclerosis, and diagnostic techniques. The special features will include the Charles Laubry lecture by John Parkinson of London; the Paul White prize lecture of the Argentine Society of Cardiology by M. Rene Malinow, D. Hojman, and A. A. Pellegrino, Buenos Aires; and the George Brown memorial lecture of the American Heart Association by Alan Burton of London, Ontario.

Paul D. White of Boston, executive director of the National Advisory Heart Council, an advisory body for the National Heart Institute, is chairman of the organizational committee for the Congress and also will serve as president. Cochairmen are E. Cowles Andrus, president of the American Heart Association, and James Watt, director of the National Heart Institute.

Scientific as well as commercial exhibits and medical film showings are scheduled. Other events will include a formal banquet featuring presentation of the 1954 Howard W. Blakeslee awards, and a series of medical sightseeing tours in the Washington area. Post-Congressional tours to leading university centers and cardiac clinics in the United States and Canada are also planned. Application blanks and detailed information may be obtained from L. W. Gorham, Secretary General, Second World Congress of Cardiology, 44 East 23 St., New York 10.

Society Elections

American Society of Medical Technologists: pres., Ruth Hovde; pres.-elect, Barbara Isbell; rec. sec., Sister Mary Simeonette Savage; treas., Kathryn Dean.

American Society of Plant Physiologists: pres., Alden S. Crafts, University of California, Davis; v. pres., Harry A. Borthwick, U.S. Bureau of Plant Industry Station, Beltsville, Md.

Astronomical League: pres., James H. Karle, Portland, Ore.; v. pres., Russell C. Maag, Sedalia, Mo.; sec., Joseph A. Anderer, Chicago, Ill.; treas., Mrs. Ralph N. Buckstaff, Oshkosh, Wis.; exec. sec., Mrs. Wilma Cherup, Pittsburgh, Pa.

Chi Beta Phi: pres., Donald C. Martin, Marshall College, Huntington, W. Va.; 1st v. pres., Mrs. Daniel Marks, Rohm and Haas, Huntsville, Ala.; 2nd v. pres., Esterina Shems, Lynchburg College, Lynchburg, Va.; 3rd v. pres., Celia Calloway, Mary Washington College, Fredericksburg, Va.; sec.-treas., Conrad B. Park, Lenoir-Rhyne College, Hickory, N.C.

Maryland Academy of Sciences: pres., Allan C. Davis, Davis Bottling Co.; v. pres., Richard H. Turk, Permeo Corp.; treas., William J. Casey, Maryland Trust Co.; sec., James W. Easter, Mt. Vernon-Woodberry Mills.

National Association of Science Writers: pres., Alton L. Blakeslee, Associated Press; v. pres., John E. Pfeiffer, New Hope, Pa.; sec.-treas., Roland Berg, Look Magazine.

National Wildlife Federation: pres., Claude D. Kelley, Atmore, Ala.; sec., Charles H. Callison, Washington, D.C.; treas., Louis W. Wendt, Great Falls, Mont. Vice presidents are Paul A. Herbert, East Lansing, Mich.; John L. Curran, Providence, R.I.; and Robert Miller, Spokane, Wash.

Phi Lambda Upsilon: pres., James M. Church, Columbia University; v. pres., Carl S. Carlson, Morton

Salt Co., Chicago; sec., Thomas B. Cameron, University of Cincinnati; treas., William G. Schrenk, Kansas State College.

Society for Investigative Dermatology: pres., Clarence S. Livingood, Detroit, Mich.; v. pres., J. Walter Wilson, Los Angeles, Calif.; sec.-treas., Herman Beerman, Philadelphia, Pa.

The **Wildlife Society:** pres., Gustav A. Swanson, Cornell University; v. pres., Thomas R. Evans, Wildlife Management Inst., St. Paul, Minn.; sec., Daniel L. Leedy, Fish and Wildlife Service, Washington, D.C.

Education

Speakers have been announced for the **Advanced Course in Radioisotope Applications in Biochemistry,** to be offered 16–24 Sept., as was announced in *Science* for 26 Mar., page 406. The topics listed, with a partial list of speakers, are as follows: "Mineral metabolism," W. D. Armstrong and R. H. Gourley; "Physiological kinetics," A. K. Solomon and J. Z. Hearon; "Hydrogen metabolism," Birgit Vennesland; "Stable Isotopes," Allan Brown; "Phospholipid problems," John L. Wood and Donald Zilversmit; "Proteins and amino acids," Henry Borsook and Paul C. Zemecnik; "Nucleic acids and nucleotides," Van R. Potter, Cyrus Barnum, and Elliott Volkin; "Purines and pyrimidines," G. Robert Greenberg, D. Wright Wilson, and John M. Buchanan; "Carbohydrate and fat metabolism," Martin Gibbs and N. E. Tolbert.

Application blanks and additional information on the course may be obtained from the Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.

Agronomy Field Day will be held at South Dakota State College on 16 Sept. The one-day program will feature new work in corn, alfalfa, sorghum, soybeans, pastures and soil fertility, according to U. J. Norgaard, Extension Service agronomist.

The Ohio State University Board of Trustees has approved plans and specifications for a **Chemical Abtracts Building** to be erected on the campus at an estimated cost of $554,292. The university and the American Chemical Society will share equally in the cost of the structure. The three-story brick building, 65 by 107 ft, will house all campus operations of *Chemical Abstracts*. The journal reports information in 33 fields of chemistry and chemical engineering as it appears in scientific journals throughout the world.

The "directory service" that its archives provide is of vital importance in chemical research and development. *Chemical Abstracts* has occupied a portion of the university's McPherson Chemical Laboratory since 1928. The new building will contain a two-level library stack room, three conference rooms, editorial offices, a reading room, a research department, and a shipping and stock room.

One-fourth of the students entering as freshman in the **Cornell University College of Engineering** in September will receive scholarships from the university with a total annual value of more than $95,000.

A new type of science course, made possible by an anonymous grant of $2500, will be offered by the University of Bridgeport (Conn.) beginning with the fall semester. To be under the supervision of Harry L. Wechter, assistant professor of chemistry, the course will deal basically with the philosophic point of view, intertwining the sciences with philosophy, yet without emphasizing that branch of learning. It will develop a broad concept of science rather than stressing any one particular area such as physics or chemistry. Laboratory work is involved. Required of student nurses, the course also will be open to other students. The plan is eventually to make it a required course for all students.

Construction of the $1,500,000 **Norman W. Church Laboratory of Chemical Biology** at the California Institute of Technology is scheduled to begin in August.

Georgia Institute of Technology recently established a curriculum leading to the B.S. degree in **Physics, Geophysics Option.** Requirements, substantially those suggested by the Geophysical Education Committee of the American Institute of Mining and Metallurgical Engineers in 1943, include the equivalent of an undergraduate major in physics with minors in both mathematics and geology, as well as courses in chemistry and engineering.

A graduate program for teachers of technological subjects, which will combine instruction in educational techniques with engineering study, will be inaugurated this fall at New York University. An M.A. degree from the NYU School of Education will be conferred upon graduates who complete 14-18 credits in education and at least 16 credits in engineering subjects. Directing the program are Thorndike Saville of the College of Engineering and Ernest O. Melby of the School of Education.

The **University of Illinois Medical School** has been presented with the private bookcases of Dr. Oliver Wendell Holmes by Dr. and Mrs. Bernard Appel of Lynn, Mass.

Six refresher courses on the laboratory techniques of the serology of syphilis and one on the management and control of syphilis serology by the regional laboratory will be held at the **Venereal Disease Research Laboratory** in Chamblee, Ga., starting at various times between Sept. 1954 and May 1955. The courses are designed to acquaint the student with the most widely used American methods for the serodiagnosis of syphilis and the latest developments or modification of technique.

Reservations will be made as soon as applications are received and lists will be closed one month before the starting date of each course. Address correspond-

ence to the Director, Venereal Disease Research Laboratory, Division of Special Health Services, PHS, Department of Health, Education, and Welfare, P.O. Box 185, Chamblee, Ga.

A Cockeroft-Walton accelerator that has seen nearly 5 yr of active service at Oak Ridge National Laboratory has been transferred to the physics department of **Vanderbilt University**, where it will be available for nuclear structure studies.

Grants, Fellowships, and Awards

The following **AAAS research grants** have been awarded:

Kansas Academy of Science to L. L. Hodgdon, Kansas State College. Archeological investigations in the Manhattan area.

South Dakota Academy of Science to E. J. Hugghins, South Dakota State College. Trematode studies at Oakwood Lakes, S. Dak.

West Virginia Academy of Science to C. Norman, West Virginia University. Preservation of bull semen frozen at low temperatures and its application to artificial insemination.

West Virginia Academy of Science to M. Feil, Marshall College. Effect of various chemicals on the learning ability of a dull strain of rats.

The **American Urological Research Foundation, Inc.**, has awarded the following research grants totaling nearly $35,000.

G. W. Fish and P. B. Hudson, Francis Delafield Hospital, Columbia University. Urinary steroid patterns in the postadrenalectomy state, $2500.

T. S Danowski, Children's Hospital, University of Pittsburgh. Renotropic property of growth hormone in chronic renal disease, $3850.

J. A. Benjamin, University of Rochester. Normal and abnormal ureter in humans and animals, $5500.

D. F. McDonald, School of Medicine, University of Washington. Role of the urine in vesical neoplasm, $8424.

E. V. Moore, University of California, Los Angeles. Treatment of urological tumors by interstitial injection of radioactive chromium phosphate, $3051.

R. Baker, Georgetown University Medical School. Relation of the endocrine system to renal calcification, $3348.

E. L. Prien and B. Walker, Boston University. Prevention of recurrent calcium containing urinary calculi in stone forming patients, $6500.

The **Colgate-Palmolive Co.** has made a $5000 grant to Rutgers University for basic radioisotopic studies in the field of therapeutic agents. The work will be carried out by the university's Bureau of Biological Research.

The **James Picker Foundation** has announced the award of nine grants and two fellowships in radiological research for the coming year. These awards, totaling approximately $42,000, were made on recommendation of the Committee on Radiology of the National Academy of Sciences–National Research Council.

Grants

H. Doubilet, New York University College of Medicine. X-ray visualization of the biliary and pancreatic ducts.

J. Friedman, Mount Sinai Hospital, Minneapolis. Effect of emotion on the mucosal pattern of the small bowel.

J. W. Grossman and J. L. Howarth, Lovelace Foundation for Medical Education and Research, Albuquerque. Development of techniques for dose estimation, using a cobalt-60 unit.

G. Jacobson and D. C. Balfour, Jr., University of Southern California School of Medicine. Use of pharmacological agents in the radiologic diagnosis of gastrointestinal disease.

H. Levi, Zoophysiological Laboratory, University of Copenhagen. Autoradiographic studies of alpha and soft beta emitters in animal tissue.

G. Middlebrook, National Jewish Hospital, Denver. Pulmonary angiographic studies pre- and postresection in tuberculosis and simulating diseases.

B. E. W. Nordenstrom, Sabbatsberg Hospital, Stockholm. Development of new principle for x-ray examination of pulmonary vessels.

H. P. Plenk, University of Utah College of Medicine. Influence of drugs on radiation reaction.

W. J. Tobin, Georgetown University School of Medicine. Bone architecture.

Fellowships

M. G. Smyth, Jr., University of Pennsylvania School of Medicine, with R. H. Chamberlain. Distribution and dosage of colloidal and particulate sources of radioactivity.

K. Subbarao, Bellevue Hospital, with M. H. Poppel. Regional ileus as a roentgenological manifestation of disease.

The possibility that lesions caused by injury or disease in any particular part of the brain produce similar psychological effects in all individuals is being studied at the Indiana University Medical Center under a $3250 grant from the **James McKeen Cattell Fund** of New York City. Ralph Reitan is project director.

The **National Research Council of Canada** has awarded 23 medical research fellowships for the coming year.

Senior medical research fellows

W. G. B. Casselman. University of Toronto, medical research.

C. N. Crowson. Queen's University, medical research.

P. C. Fitz-James. University of Western Ontario, medical research.

R. W. Gunton. University of Toronto and Toronto General Hospital, medical research.

F. C. Heagy. University of Western Ontario, biochemistry and bacteriology.

H. Kalant. University of Toronto, pathological chemistry.

J. T. Nichol. University of Western Ontario, biophysics.

J. W. Pearce. University of Western Ontario, medical research in physiology.

Graduate medical research fellows

D. E. Bergsagel. University of Oxford, blood coagulation.

R. W. Cornett. Queen's University, cardiovascular physiology.

T. E. Cuddy. University of Manitoba, cardiovascular physiology.

A. Davignon. Hotel Dieu Hospital, physiology and biochemistry.

F. M. Hill. University of Toronto, pathology.

N. Kalant. New England Center Hospital, Boston, endocrinology.

S. J. Klebanoff. University of Toronto, pathological chemistry.

D. Ley. Toronto Western Hospital, iron metabolism in neoplastic disease.

A. Malkin. McGill University, biochemistry.

J. C. Nixon. University of Toronto, biochemistry.

J. E. Nixon. University of British Columbia, physiological and pharmacological problems related to anesthesiology.

P. Pollock. Mt. Sinai Hospital, New York, cardiology.

I. C. Radde. University of Toronto, endocrinology.

R. F. Scott. London Postgraduate Medical School, Hammersmith Hospital, pathology.

J. M. Vale. University of Toronto, endocrinology.

The **National Science Foundation** will award individual grants to defray partial travel expenses of a limited number of scientists who will attend the **6th International Congress of Anatomy** in Paris, July 1955. Applications forms may be obtained from the National Science Foundation, Washington 25, D.C. *They must be submitted by 2 Jan. 1955.*

Book Reviews

Silicones and Their Uses. Rob Roy McGregor. McGraw-Hill, New York, 1954. 302 pp. Illus. $6.

This volume, the third to appear in this country on the general subject of silicones, is a practical treatise about what silicones are, how they are made, and in what ways they are useful. The author has enjoyed a close connection with the science and technology of silicone materials for 15 years, principally as administrative head of the multiple fellowship at Mellon Institute sponsored by the Corning Glass Works and The Dow Corning Corporation. He has put this experience to good use in the present task, coming up with an authoritative discussion of all the practical aspects of silicone polymers.

After a brief introduction, the author devotes a chapter to each of the five major aspects of the subject. Chapter 1, on the history of silicones, is short, interesting, and at times fanciful. Chapter 2, on the general types of commercial silicones, constitutes half of the book—silicone "fluids," "compounds" (in the sense that the rubber compounder uses the term), lubricants, resins, rubber, and bouncing putty are treated in separate sections, each complete with tables of properties of the representative Dow Corning materials appropriate to that section. Past and present uses for each type of polymer are described, and some projected uses are discussed. Chapter 3, on the physiological response to silicones, devotes 11 pages to the investigations of effects on experimental animals, proving mostly that there is no physiological response. This conclusion opens the way to a variety of interesting proposed uses in medicine and in the cosmetics industry. Chapter 4 takes up the applications of silicones in specific industries, in the form of a well-organized list of such applications according to type of industry. Several pages on cost considerations follow, showing that the price of silicone materials has been falling since 1942, while everything else has been going Chapter 5 reviews the preparation of silicone i mediates and then takes up the various methods of polymerization. A bibliography of 152 listings and an index of eight pages complete the volume.

McGregor plainly states that he is writing for the general reader, and especially for engineers, designers, and practical scientists who may want to use silicones to solve a particular problem. He makes it equally plain that he is not writing for the research chemist or chemical specialist in the field of silicones. This is not to say that the book contains little about the chemistry of silicones; it contains a great deal of chemical information, some of it in unexpected places. However, the chapter expressly devoted to the chemistry of silicone preparation takes up matters from an elementary level, and anyone with at least freshman training in chemistry should be able to follow the narrative and the reactions. If he does, the reader will have a reasonably good understanding of what goes on in the manufacture and use of silicones. He may then want to proceed further in other sources.

There is no doubt in my mind that this book has accomplished the author's purpose and that many people in applied science and the practical arts will find it exceedingly useful. Another author might have defined and described things quite differently, but none could have achieved in the final result any greater practical utility.

E. G. Rochow
Department of Chemistry, Harvard University

Methods of Theoretical Physics, pts. I and II. Philip M. Morse and Herman Feshbach. McGraw-Hill, New York–London, 1953. xxx + 1978 pp. Illus. $30 the set, $15 each volume.

This is a monumental work. At first glance, one wonders at the enormous effort involved in collecting, organizing, systematizing, and presenting such a mass of material. Further study evokes a steadily growing admiration and gratitude that the tremendous work has been done and that an amazing amount of useful material has been made available to physicists. This is not to say that it can be read in a hurry. It must be studied. But one who needs to know the subject matter can find it.

The title is an accurate description of the contents. The unity, the organization, and the material of the book are based on the methods rather than on the subject matter of theoretical physics, which means that the book is on mathematics but mathematics in the physicist's sense. Little attention is paid to rigor as a mathematician understands it, but much attention is given to the applicability to physical problems. Classical mechanics, optics, electromagnetic theory, and quantum mechanics are frequently dealt with together, as in the sections on field theory.

Some of the chapters would make, in themselves, good courses in mathematics for physicists. One hundred forty pages on functions of a complex variable and 180 pages on ordinary differential equations provide, in a concise form, most of the techniques needed in these fields and provide them with minimum emphasis on analytic rigor and maximum emphasis on intuitive (geometric) understanding.

Extensive discussions of approximate methods prepare the reader for the "facts of life" in theoretical physics, as opposed to classroom situations where most problems can be treated in closed form.

As is to be expected from the activities and interests of the senior author, the solutions of Laplace's and Poisson's equations and of the wave equation are given full attention. In these chapters, as in most other chapters, a valuable tabulation of solutions, functions, and other material is appended. In fact, the tabulations at the ends of the various chapters

would provide, in themselves, a valuable reference book.

The range of subjects treated is remarkably complete, reminiscent of the "German handbook" tradition. In addition to the subjects already mentioned, others of particular interest are the treatments of integral equations, the diffusion equations, and the equations for vector fields. The only obvious omission is a lack of emphasis on algebraic methods. The correspondence of matrices with operators is mentioned, but there is no discussion of the group theoretical methods that have found extensive applications in problems related to crystals, molecules, and atoms.

The authors indicate in the preface that the book is an outgrowth of a course given at the Massachusetts Institute of Technology, and numerous problems are included whose solution by the reader would aid materially in his understanding of the subject matter. It seems improbable, however, that these two thick volumes can serve as a textbook in a graduate course of the usual extent. One could imagine that a first-class student, by devoting his full time to it, might work through the material in the course of an academic year but probably in not much less. Although its use as a textbook in the usual way seems doubtful, there is no doubt that this book will occupy a prominent position on the desks of almost all working theoretical physicists and will soon come to be the standard reference work for the mathematical techniques in physics.

W. V. Houston

The Rice Institute

Les Groupes Sanguins Chez les Animaux. Individualités sanguine et tissulaire. R. Dujarric de la Rivière and A. Eyquem. Editions Médicales Flammarion, Paris, 1953. 407 pp. Illus. F. 3275.

The predominant tone of this ninth member of the *Collection de l'Institut Pasteur* is that of an encyclopedia of observations on animal blood groups and tissue individuality. As such, the book provides a useful set of summaries and references. If one wishes to know what conclusions have been drawn from blood-group studies of ducks, chickens, pigeons, horses, asses, cattle, sheep, goats, swine, cats, ferrets, dogs, rabbits, guinea pigs, rats, or monkeys, he will find almost all of them here. If one is curious about the existence or nature of maternal-fetal incompatibility in animals, he will find an exhaustive abstract of the literature. If one seeks a strong historical presentation of tissue specificity, particularly from the viewpoints of "cytotoxic antibodies" or of grafts, he will find many references and conclusions in this survey. About two-thirds of the text pages and most of the more than 850 references deal with these subjects. The authors rarely attempt more than the presentation of conclusions drawn in the papers to which they refer.

The references are marred by frequent typographical errors. To cite only a few examples, T. H. Morgan is credited with work done by W. T. J. Morgan; W. H. McGibbon is Mac Gibbon in much but not all the text, and Gibbon (Mac) in the bibliography; Beadle becomes "Beadie," and sex chromosomes "sex hormosomes"; Wiener's *Blood Groups and Transfusion* was published in 1945 or 1948 depending on where it is found in the references.

Broader aims for the book are expressed in the first 122 pages, which offer general treatments of serology and genetics and a detailed presentation of serological techniques, with primary reference to work on human cellular antigens. The general fields are covered in a fashion that seems likely to irritate the expert and either confuse the novice or mislead him into an opinion that he has achieved an easy mastery of these subjects. After a 16-page presentation of genetics, there are more than two cautious pages on the "Théorie de Mitchourine." The authors choose not to discount the interest provoked by the Russian theory, especially in its application to arboriculture, but to affirm the value of the "chromosome theory of heredity."

Ray D. Owen

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Automatic Digital Calculators. A. D. Booth and K. H. V. Booth. Academic Press, New York, 1953. vii + 230 pp. Illus. + plates. $6.

It has been predicted that we are now entering a new phase of the Industrial Revolution wherein machines will relieve men of tedious and difficult mental labor, just as they relieved men of tedious and difficult physical labor during the first phase of the Revolution. Whether or not such a prediction is accurate, it certainly is true that there is today a great need for scientists with some knowledge of the design and use of automatic digital calculators. There is a corresponding need for a good textbook to be used as an introduction to the subject, and the authors state in the preface that they intend their book to be such a guide.

The general organization is excellent. The first three chapters review the history of digital calculators and examine many of the machines now in existence. The following chapters, which comprise more than half of the book, list the basic electronic and mechanical components from which a computer is built and describe how the components are put together in a computing system. In the last five chapters, the authors explain how problems are prepared for solution by a computer, and mention some unusual computer applications.

However, it is difficult to recommend as a textbook one that omits so many important points and differs in so many respects from current practice. The chapters on circuit design do not even mention the importance of reliability or the steps that must be taken to insure circuit stability. The use of mathematical techniques in logical design is ignored. To this partial list of omissions must be added incorrect statements and some dubious and controversial arguments. It is

not correct that ". . . negative numbers are invariably stored in complement form" (p. 44). One chapter on coding attempts to justify the use of interpolation techniques in the evaluation of basic functions, although this method is not adequately compared with others that are more widely used. A statement that will provoke considerable argument is made on page 169, where the authors declare that floating-point subroutines ". . . should be regarded as a last resort rather than as an easy alternative to careful planning."

In short, although this book probably covers the field better than any existing volume, it can be recommended as a textbook only if it is to be supplemented and corrected by someone who is well acquainted with the art of automatic computing.

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Microwave Spectroscopy. M. W. P. Strandberg. Wiley, New York; Methuen, London, 1954. vi + 140 pp. Illus. + plates. $2.50.

Microwave spectroscopy had its origin about 20 years ago, but its major progress has been made in the last 8 or 9 years. Along with its rapid growth, an extensive literature has appeared in periodicals. However, this volume, so far as I know, is one of two books (my review of the other appears in the next column) written on the subject

Microwave Spectroscopy by Strandberg deals, in the words of the author,

> . . . with a calculation of the quantum energy levels of a rotating molecule, and considers the various perturbations which may or must be recognized to interpret precise experimental data. The final sections deal with the instrumentation necessary to measure the frequencies in the microwave region which are characteristic of differences between these energy levels.

The book is tersely written; to read it with understanding requires an extensive background in the matrix formulation of quantum mechanics and a considerable capability in mathematics—that is, the use of tensors in the chapter on nuclear quadrupole energy. The chapters on experimental considerations are likewise compact and assume familiarity with microwave techniques. A brief bibliography and three appendixes conclude the book. Appendixes I and II are tables of reduced energy and line strengths, respectively. Appendix III gives rotational magnetic moment matrix elements on the space-fixed Z(M) axis.

It seems to me that there might be many readers surveying this important field who would be discouraged from completing a study of this book because of the condensed manner in which it is presented. But Strandberg makes no particular claim that this is the group to whom he is appealing. There is no doubt that anyone who desires to do research in the field of microwave spectroscopy must master the theory outlined in this scholarly work.

Microwave Spectroscopy. Walter Gordy, William V. Smith, and Ralph F. Trambarulo. Wiley, New York; Chapman & Hall, London, 1953. xii + 446 pp. Illus. $8.

The preface of this book states that the understanding of microwave spectroscopy requires knowledge of several branches of theoretical physics, chemistry, electronic circuitry, and microwave components. The aim of the book is to provide a convenient source of information on the significant spectroscopic components and a survey of the theory fundamental to understanding this important field. This aim, in my estimation, is successfully accomplished. The contents include information on instruments and experimental methods, microwave spectra of gases, solids, and liquids, the Stark and Zeeman effects, molecular structures, and a variety of other topics. Numerous photographs, charts, graphs, and circuit diagrams enhance the value of the book.

This book was not written primarily as a textbook, but because of the clarity and detail with which much of the material is presented, it might be useful as such.

There is a long list of pertinent references at the end of each chapter, and the book closes with a chronologically arranged bibliography of important published papers on the applications of microwave spectroscopy to gases, paramagnetic resonance of solids and liquids, and ferromagnetic resonance. This should be of great value to anyone who has to search the literature for specific information. The appendix contains an extensive tabulation of data useful to the worker in this field. This volume should be of considerable value to students and research workers in this field.

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The Metabolism of Algae. G. E. Fogg. Methuen, London; Wiley, New York, 1953. ix + 149 pp. Illus. $2.

This brief book attempts to cover the biochemistry of a very large group of diverse plants, ranging from unicellular forms closely related to bacteria to the seaweeds of commercial importance. It is evident that the available knowledge varies widely from one organism to another. Certain unicellular species that for technical reasons are suitable for studies of photosynthesis are well known from the point of view of intermediary metabolism. In contrast, the seaweeds have been of interest primarily from the point of view of the end-products of metabolism, such as the polysaccharides.

Chapters are devoted to the photosynthetic and

chemosynthetic assimilation of carbon and to autotrophic and heterotrophic assimilation of nutrients. Also considered are the end-products of metabolism and various aspects of growth.

Because of the very broad field covered in a limited space, this book is not an intensive monograph and has little to offer the specialist. To students and research workers who desire a brief survey of the biochemical literature of this heterogeneous group of plants, this book will offer much information of interest. The bibliography of some 300 items and the index add to the value of the book. It is well worth the price asked.

M. H. Adams

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New York University College of Medicine

Introduction to Tensors, Spinors, and Relativistic Wave-Equations (Relation Structure). E. M. Corson. Hafner, New York, 1953. xii + 221 pp. $10.

The phrase *relation structure* in the title is important to an understanding of the content of this valuable book and of the point of view from which it is written. The existence of half-integral spin fields in the description of the elementary particles is very deeply connected with the existence of an essentially two-valued representation of the basic group of physics. This purely mathematical fact that the proper (homogeneous) Lorentz group is rightly regarded as one of many homomorphic images of the more fundamental spin representation group leads to an extensive and intricate set of interrelationships among various transformation groups, their infinitesimal generators, and the spaces on which they operate. It is with these structural relationships that the author is concerned, and they give his book a permanence of value it could not otherwise achieve in view of the somewhat chaotic and incomplete state of the physical theory expounded.

The first two chapters form part I, "Mathematical introduction," and establish the basic mathematical framework of the tensor and spinor analysis, respectively. The selection of material here is explained in the preface:

> Our presentation is based on the view that the theoretical physicist is primarily interested in the intelligent application of the rules of the spinor calculus, rather than in the more abstruse geometrical theory of the pure mathematician (which is not intended to detract from the necessity and beauty of the latter development).

The result of this policy decision is that the spinor formalism is developed mercilessly and is used with casual ease. Since there is every indication that the author himself has understood the underlying geometry (not so abstruse, really), the loss of clarity is not as great as might be expected from dependence on the massive notational framework with its multiplicity of indices. (The only extended treatment of this geometry in the formalism of the present volume known to me is in the 1935–36 notes on lectures by O. Veblen and myself entitled "Geometry of complex domains." These have been long out of print and unavailable but are now being reprinted at The Institute for Advanced Study, Princeton, N.J.).

The second part, "Physical principles," treats the general field theory and relativistic wave-equations in their field and matrix-algebraic aspects. Beginning with a Lagrangian density, the variation principle is used to derive field equations. Other topics in Chapter 3 include conservation theorems, gauge invariance, interaction of electromagnetic and matter fields, and canonical Hamiltonian formulation of the field theory.

The Dirac-Fierz-Pauli theory is given major attention in Chapter 4, but the Chandra and Proca contributions are also considered, the 4-spinor formulation is developed, and there is a concluding section on spin and statistics.

The final and longest chapter (66 pp.) reconsiders and systematizes the theory from the point of view of the representations of the homogeneous and inhomogeneous Lorentz groups, as developed by Wigner, Bargmann, Gelfand, Neumark, and others. Here the powerful concepts of the structure of algebras are used to establish the essential identity of apparently different wave-equations.

The book is rich in its detail, is literate in style, and contains a valuable bibliography and index. The printing was done by Blackie and Son in Glasgow and fully sustains the high reputation of that firm. While the book is certainly very difficult to read, and a small part of this should be charged to the author, the contribution it makes to the foundations of theoretical physics is considerable.

Wallace Givens

Department of Mathematics,
University of Tennessee, and
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An Illustrated Catalogue of the Rothschild Collection of Fleas* (Siphonaptera) *in the British Museum, vol. I. ***Tungidae and Pulicidae.*** G. H. E. Hopkins and Miriam Rothschild. British Museum (Natural History), London, 1953. 361 pp. Illus. + plates. £4 4s.

G. H. E. Hopkins, assistant to Karl Jordan at Tring and recently retired from the British African Service as a medical entomologist, is a top authority on world fleas. Miriam Rothschild, daughter of the late N. C. Rothschild, founder, one might say, of world siphonaptery, is a specialist in bird fleas and underwriter of the cost of this elaborate catalogue.

The unexcelled art work is made up of line drawings, many comparative, mostly from the pen of Jordan's young assistant, F. G. A. M. Smit, who is an artist in his own right and an enthusiaste student of world fleas. Some are from the originals or are a modification of them. The photomicrographs, which make

up a section of their own, are a new feature in flea study and are exquisitely done.

The work is dedicated to Karl Jordan, father and dean of the students of fleas the world over, and friend, companion, and associate of the late N. C. Rothschild. Through the foresight and vision of Rothschild and Jordan the *Catalogue* now becomes possible.

Volume I contains: a foreword related to the history of the Tring Museum and the work of Rothschild and Jordan there; an introduction that covers the scope of this effort, the phylogenetic relationships of the fleas, and a series of other pertinent items; a most extraordinary glossary; a key to the superfamilies and families of fleas; a review of the family Tungidae that covers six species of Tunga, 14 of Hectopsylla, and two of Rhynchopsyllus; a 288-page review of the family Pulicidae that covers 15 species of Echidnophaga, one each of Delopsylla, Juxtapulex, Moeopsylla, Centetipsylla, Nesolagobius, Spilopsyllus, Ornithopsylla, Actenopsylla, Synopsyllus, and Parapulex, two each of Archaeopsylla, Aphropsylla, and Pariodontis, three each of Pulex and Cediopsylla, five each of Hoplopsyllus, and Synosternus, six of Procaviopsylla, eight of Ctenocephalides, 54 of Xenopsylla. All of these species are keyed, illustrated, and described together with world-wide records. The appendix contains the "deed of gift," dated 27 February 1913, bestowing the Rothschild collection of fleas to the British Museum. There is also a portion of the "last will and testament" of N. C. Rothschild, endowing the collection for the Museum. The index is brief but adequate. Figure 466 is a fold-up map of the world, illustrating the zoogeographical areas. The final 100 pages of the volume are the photomicrographs with their tables of explanation.

As one browses through the pages of the *Catalogue*, one is ever conscious of the presence of the ghostwriters, Nathaniel Charles Rothschild and Karl Jordan, the pioneers of siphonaptery, whose works are here commemorated.

C. ANDRESEN HUBBARD

Tigard, Oregon

Quantitative Organic Analysis via Functional Groups, Sidney Siggia. Wiley, New York and Chapman & Hall, London, ed. 2, 1954. 227 pp. Illus. $5.

The author has expanded by 75 pages the first edition of this brief book on the quantitative determination of functional groups in organic compounds. The introduction of 14 new procedures now makes available clear and concise directions for about 38 functional groups. Minor changes have been made in the methods presented in the first edition, where experience showed that increased accuracy and precision could be obtained. The literature source of each method is given, and the author has indicated the scope and limitations of the procedures.

A brief discussion of the use of phase diagrams for analyzing mixtures by titration to a turbidimetric endpoint has been added. Also, a short discussion, with a good specific example, of the value of functional group determination in the identification of compounds is included.

This book is useful, not only to all analytical chemists but also to research chemists.

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Books Reviewed in THE SCIENTIFIC MONTHLY

August

Arctic Bibliography, vols. 1–3, Arctic Institute of North America (Supt. of Documents). Reviewed by Trevor Lloyd.

Jaarboek, 1952–1953, Koninklijke Nederlandse Akademie van Wetenschappen (Noord-Hollandsche Uitgevers). Reviewed by D. ter Haar.

The Living Brain, W. Grey Walter (Norton). Reviewed by Robert H. Oster.

General Virology, S. E. Luria (Wiley; Chapman & Hall). Reviewed by S. Edward Sulkin.

Advances in Virus Research, vol. I, Kenneth M. Smith and Max A. Lauffer, Eds. (Academic Press). Reviewed by G. W. Beadle.

Mitosis, Franz Schrader (Columbia Univ. Press). Reviewed by D. G. Catcheside.

Paying for Medical Care in the United States, Oscar N. Serbein, Jr. (Columbia Univ. Press). Reviewed by Russel V. Lee.

Chemical Methods in Industrial Hygiene, Frederick H. Goldman and Morris B. Jacobs (Interscience). Reviewed by Karl L. Dunn.

Educational Wastelands, Arthur E. Bestor (Univ. of Illinois Press). Reviewed by Fletcher G. Watson.

Energy in the Future, Palmer C. Putnam (Van Nostrand). Reviewed by Warren Weaver.

Keeping and Breeding Aquarium Fishes. C. W. Emmens (Academic Press). Reviewed by Christopher W. Coates.

New Books

Insect Fact and Folklore. Lucy W. Clausen. Macmillan, New York, 1954. xiv + 194 pp. Illus. $3.50.

A Treatise on Conic Sections. George Salmon. Chelsea Publ., New York, ed. 6, 1954. xv + 399 pp. Illus. Paper, $1.94; cloth, $3.25.

The Structure of Metals and Alloys. William Hume-Rothery and G. V. Raynor. Institute of Metals, London, ed. 3, 1954. viii + 363 pp. Illus. + plates. $5.50.

Learning Theory, Personality Theory, and Clinical Research. The Kentucky Symposium. Donald K. Adams *et al.* Wiley, New York; Chapman & Hall, London, 1954. ix + 164 pp. Illus. $3.50.

Optical Image Evaluation. Proc. NBS Symposium held 18–20 Oct. 1951. National Bureau of Standards, Washington, 1954 (Order from Supt. of Documents, GPO, Washington 25). x + 289 pp. Illus. $2.25.

The Pharmacologic Principles of Medical Practice. John C. Krantz, Jr., and C. Jelleff Carr. Williams & Wilkins, Baltimore, ed. 3, 1954. xxi + 1183 pp. Illus. + plates. $12.

Microbes and You. Stanley E. Wedberg. Macmillan, New York, 1954. ix + 439 pp. Illus. $4.50.

The Permanent Revolution in Science. Richard L. Schanck. Philosophical Library, New York, 1954. xvi + 112 pp. $3.

Wildcat Strike. Alvin W. Gouldner. Antioch Press, Yellow Springs, Ohio, 1954. 179 pp. Illus. $3.

The Moon Puzzle. A revived classical theory correlating the origin of the moon with many problems in natural science. N. O. Bergquist. Grafisk Forlag, Copenhagen, 1954. xiii + 378 pp.

Physiology and Biochemistry of the Skin. Stephen Rothman. Univ. of Chicago Press, Chicago, 1954. xiii + 741 pp. Illus. $19.50.

Stratigraphy and History of the Moenkopi Formation of Triassic Age. Edwin D. McKee. Geological Society of America, New York, 1954. vii + 133 pp. Illus. + plates.

Pygmies and Dream Giants. Kilton Stewart. Norton, New York, 1954. 295 pp. $3.75.

Teachers Manual for College Chemistry in the Laboratory. No. 2. Lloyd E. Malm and Harper W. Frantz. Freeman, San Francisco, 1954. 341 pp. Illus. Paper, $3.30.

Health and Safety for You. Harold S. Diehl and Anita D. Laton. McGraw-Hill, New York–London, 1954. xii + 515 pp. Illus. $3.76.

Psychoanalysis and the Education of the Child. Gerald H. J. Pearson. Norton, New York, 1954. x + 357 pp. $5.

New and Nonofficial Remedies. Council on Pharmacy and Chemistry, American Medical Association. Lippincott, Philadelphia, 1954. xlix + 609 pp. $2.65.

Fundamentals of Psychoanalytic Technique. Trygve Braatøy. Wiley, New York; Chapman & Hall, London, 1954. xi + 404 pp. $6.

A History of the School of Engineering, Columbia University. James Kip Finch. Columbia Univ. Press, New York, 1954. vii + 138 pp. + plates. $2.75.

Sir Issac Newton. E. N. da C. Andrade. Collins, London; Macmillan, New York, 1954. 140 pp. Illus. $1.75.

Anatomy of Weeds. Emil Korsmo. Grondahl, Oslo, 1954. 413 pp. Illus. 100 kr.

The Optical Properties of Organic Compounds. Alexander N. Winchell. Academic Press, New York, ed. 2, 1954. xviii + 487 pp. Illus. $12.

Spot Tests. vol. I, *Inorganic Applications*, xii + 518 pp. $6.50. vol. II, *Organic Applications*. xv + 436 pp. Illus. $6.25. Fritz Feigl. Trans. by Ralph E. Oesper. Elsevier, Houston–Amsterdam, ed. 4, 1954.

Principles of General Ecology. Angus M. Woodbury. Blakiston, New York, 1954. viii + 503 pp. Illus. $6.

Tomorrow Is Already Here. Robert Jungk. Simon & Schuster, New York, 1954. x + 241 pp. $3.50.

The Psychiatric Interview. Harry Stack Sullivan. Helen Swick Perry and Mary Ladd Gawel, Eds. Norton, New York, 1954. xxiii + 246 pp. $4.50.

Ships, Machinery, and Mossbacks. The autobiography of a naval engineer. Harold G. Bowen. Princeton Univ. Press, Princeton, N.J., 1954. vii + 397 pp. $6.

Laboratory Manual on Fundamental Principles of Bacteriology. A. J. Salle. McGraw-Hill, New York–London, ed. 4, 1954. x + 176 pp. Illus. + plates. $3.50.

Guide for Safety in the Chemical Laboratory. General Safety Committee of the Manfacturing Chemists' Assoc. Van Nostrand, New York, 1954. xiii + 234 pp. Illus. $4.25.

Miscellaneous Publications

Inquiry into the Purpose of the Production of Wealth. Roy A. Foulke. Dun & Bradstreet, New York 8, 1954. 71 pp.

Social Planning in America. Short Studies in Sociology, No. 3. Joseph S. Himes. Doubleday, Garden City, N.Y., 1954. 59 pp. 95¢.

Today's Research and Tomorrow's World. Vannevar Bush. Stanford Research Inst., Stanford, Calif., 1954. 16 pp.

Forest Statistics for the Eastern Shore of Maryland. Rpt. No. 3. Northeastern Forest Expt. Sta., Upper Darby, Pa., 1954. 17 pp.

You and Your Allergic Skin. Herman Hirschfeld. Nelson House, New York 28, 1954. 24 pp. 25¢.

Slash Pine* (Pinus Elliottii), *including South Florida Slash Pine Nomenclature and Description. Sta. Paper No. 36. Elbert L. Little, Jr., and Keith W. Dorman. 82 pp. Illus. ***Lumber Grade Yields in the Loblolly-Shortleaf Pine Type by the Southern Pine Log Grades.*** No. 37. T. A. McClay. 12 pp. Illus. ***Defects in Hardwood Veneer Logs: Their Frequency and Importance.*** No. 39. E. S. Harrar. 45 pp. Illus. Southeastern Forest Expt. Sta., Asheville, N.C., 1954.

Proceedings Volume of the Geological Society of America for 1953. The Society, New York, 1954. 228 pp. Illus. + plates.

On a Collection of Indian Ichneumonidae (Hymenoptera) in the Forest Research Institute, Dehra Dun. Indian Forest Records: Entomology, vol. 8, No. 8. S. N. Rao. Manager of Publ., Delhi, India, 1953. 65 pp. Illus. 9s.

Symposium on Microseisms. Held at Harriman, N.Y., 4–6 Sept. 1952. Natl. Acad. of Sciences–Natl. Research Council, Washington 25, 1953. 125 pp. Illus.

Production of Natural Gas Substitutes by Pressure Hydrogasification of Oils. Interim report. H. R. Linden, J. J. Guyer, and E. S. Pettyjohn. Inst. of Gas Technology, Chicago 16, 1954. 35 pp. Illus. $2.50.

How to Attract and Hold Engineering Talent. Executive Research Survey No. 3. Professional Engineers Conference Bd. for Industry, Washington 5, 1954. 60 pp. $2.

Welding Alcoa Aluminum. Aluminum Co. of America, Pittsburgh 19, 1954. 176 pp. Illus. Gratis.

Nutritional Factors and Liver Diseases. Annals, vol. 57, art. 6. Klaus Schwartz *et al.* N.Y. Acad. of Sciences, New York 21, 1954. 346 pp. Illus. $4.50.

Economic Progress and Economic Change. 34th annual report. Solomon Fabricant. Natl. Bur. of Economic Research, New York 16, 1954. 97 pp. Gratis.

A Call for Action To Meet the Impending Increase in College and University Enrollment. Amer. Council on Education, Washington 6, 1954. 29 pp. Illus.

List of Publications of the Commonwealth Scientific and Industrial Research Organization, Australia, to December 1953. 32 pp. ***Divisions and Sections as at 1 January 1954.*** 15 pp. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia, 1954.

Distribution of Californian Mosses. Leo Francis Koch. Univ. of Notre Dame Press, Notre Dame, Ind., 1954. 23 pp. Illus.

Where East Is West: European Enclaves in Asia. Studies in Business and Economics, vol 8, No. 1. Bur. of Business and Economic Research, Univ. of Maryland, College Park, 1954. 16 pp. Illus.

Compounding Silicone Rubber with Dow Corning Gum. Dow Corning Corp., Midland, Mich., 1954. 28 pp. Illus.

Hybrid Inviability between* Rana Pipiens *from Wisconsin and Mexico. Tulane Stud. Zool., vol. 1, No. 9. E. Peter Volpe. Tulane Univ., New Orleans, 1954. 12 pp. Illus. 35¢.

A Commutatorless D-C Tachometer. Reprint Bull. No. 39. A. R. Eckels and Walter R. Peck. 4 pp. Illus. ***Recent Developments in the Building Brick Industry of the Southeastern United States.*** Reprint Bull. No. 40. William C. Bell. 2 pp. Illus. ***Calculation of Impounded-Storage Requirements.*** Reprint Bull. No. 41. Charles Smallwood, Jr., Herbert B. Wyndham, and Daniel N. Cote. 6 pp. Illus. ***Thermodynamic Properties of Liquid Sodium.*** Reprint Bull. No. 42. J. F. Lee. 3 pp. Dept. of Engineering Research, N.C. State College, Raleigh, 1954.

Annual Report of the Northeastern Forest Experiment Station, 1953. Northeastern Forest Expt. Sta. Upper Darby, Pa., 1954. 85 pp. Illus.

Costs, Quality, and Prices of Fluid Milk in Rural and Urban Areas of Utah and Montana. Bull. 365. Wells M. Allred and Edward H. Ward. Agr. Expt. Sta., Utah State Agr. College, Logan, 1953. 40 pp. Illus.

French Bibliographical Digest (Biology-Botany-Zoology). Ser. II, No. 9. Georges Assié, Ed. Cultural Div. of the French Embassy, New York 21, 1953. 96 pp.

On Two New Bembroid Fishes from the Deep Sea off Mie Prefecture with Special Reference in Relation to Hitherto Known Species and ***A New Blennoid Fish from the Sea of Japan.*** Rpt. of Faculty of Fisheries, vol. 1, No. 2. Yaichiro Okada and Kiyoshi Suzuki. Prefectural Univ. of Mie, Mie Prefecture, Japan, 1952. 10 pp. Illus.

Scientific Researches of Mellon Institute 1953–1954. Annual Rpt. Ser., No. 41. Mellon Inst., Pittsburgh 13, 1954. 56 pp. Illus. Gratis.

J. F. Naumann's Briefwechsel mit H. Lichtenstein 1818–1856. Acta Historica Scientiarum Naturalium et Medicinalium, vol. 11. Erwin Streseman and Peter Thomsen. Ejnar Munksgaard, Copenhagen, 1954. 74 pp. Kr. 10.

Expert Committee on Malaria, Fifth Report. Tech. Rpt. Ser., No. 80. World Health Organization, Geneva, 1954 (Order from Columbia Univ. Press, New York 27). 42 pp. 25¢.

Standardization of Microchemical Apparatus and Methods. 9th annual Microchemical Symposium held 19–20 Mar. 1954. Metropolitan Microchemical Soc., New York, 1954. 43 pp.

Proceedings of the Third Research Conference on Psychosurgery. Held in New York, 19–20 Oct. 1951. Public Health Service Pub. No. 221. Winfred Overholser, Ed. Natl. Inst. of Mental Health, Washington, 1954 (Order from Supt. of Documents, GPO, Washington 25). 173 pp. Illus. $1.

Stories of Lassen's Place Names. Paul E. Schulz. Loomis Museum Assoc., Mineral, Calif., 1949. 62 pp. Illus. 40¢.

High School Retention by States. Circ. No. 398. Walter H. Gaumnitz. U.S. Dept. of Health, Education, and Welfare, Office of Education, Washington 25, 1954. 19 pp.

The Discovery of Unicellular Life. Leeuwenhoek keepsake. Excerpts from communications by Antoni van Leeuwenhoek to the Royal Society of London (7 Sept. 1674 and 9 Oct. 1676). Chronica Botanica Co., Waltham 54, Mass., 1954. 14 pp. Gratis.

Civil Defense and Higher Education. Amer. Council on Education, Washington 6, 1954. 15 pp. Gratis.

Survey and Treatment of Marsh Deposits. Highway Research Bd., Bibliog. 15. Natl. Acad. of Sciences–Natl. Research Council, Washington 25, 1954. 95 pp.

Marine Polychaete Worms from Point Barrow, Alaska, with Additional Records from the North Atlantic and North Pacific. Proc. U.S. Natl. Museum, vol. 103, No. 3324. Marian H. Pettibone. Smithsonian Institution, Washington, 1954. 153 pp. Illus.

Collected Research Papers for Spring 1954. Symposium ser., vol. 50, No. 10. F. J. Van Antwerpen, Ed. 142 pp. Illus. ***Nuclear Engineering—Part I.*** vol. 50, No. 11. F. J. Van Antwerpen, Ed. 280 pp. Illus. Amer. Inst. of Chemical Engineers, New York 17, 1954

Estudio Botánico de las Vezas y Arvejas Españolas. Emilio Guinea. Instituto Nacional de Investigaciones Agronómicas, Madrid, 1953. 227 pp. Illus. P. 70.

***Preliminary Revision of the Genus* Pselaptrichus.** Trans., vol. 12, No. 2. Gordon A. Marsh and Robert O. Schuster. San Diego Soc. of Natural History, San Diego, Calif., 1954. 28 pp. Illus. + plates.

Pesticide Situation for 1952–53. Production and Marketing Administration, U.S. Dept. of Agriculture, Washington, 1953. 36 pp. Illus.

Synthesis and Physical-Chemical Properties of New Aromatic Amidines. Annals, vol. 58, art. 3, Martin Kuna and M. J. Kopac. 31 pp. $1. ***Reserpine (Serpasil) and Other Alkaloids of* Rauwolfia Serpentina: *Chemistry, Pharmacology, and Clinical Applications.*** vol. 59, art. 1, Fredrick F. Yonkman *et al.* 140 pp. Illus. $3. N.Y. Acad. of Sci., New York 21, 1954.

Normas para la Preparación de Trabajos Científicos. Sección Tesis de Grado y Ensayos, No. 6. Alfonso Trejos and Rodrigo Zeledon A. Universidad de Costa Rica, San José, 1953. 69 pp. Illus.

Fósforo Inorgánico del Suero y Metabolismo Glucídico. F. De Venanzi and M. Roche. Instituto de Investigaciones Médicas, Caracas, Venezuela, 1954. 47 pp.

Proceedings: Second National Conference on Trichinosis. 1 Mar. 1954. Public Health Service, Communicable Disease Center, Atlanta, 1954. 76 pp. Illus.

Selected Bibliography on Building Construction and Maintenance. Building Materials and Structures Rpt. 140, L. D. C. Nobel. Natl. Bur. of Standards, Washington 25, 1954 (Order from Supt. of Documents, GPO, Washington 25). 35 pp. 30¢.

Commercial Feeding Stuffs, Report on Inspection, 1953. Bull. 582. H. J. Fisher. Conn. Agr. Expt. Sta., New Haven, 1954. 116 pp.

Tabla de Composición de Alimentos Colombianos. José Gongora y López and Norton Young López. Instituto Nacional de Nutrición, Bogotá, Colombia, 1953. 79 pp. Illus.

Reproduction of Cockroaches. Smithsonian Misc. Coll., vol. 122, No. 12. Louis M. Roth and Edwin R. Willis. Smithsonian Institution, Washington 25, 1954. 49 pp. + plates.

Scientific Institutions and Scientists in Latin-America. America Central, vol. 1. UNESCO, Montevideo, Uruguay, 1954. 201 pp.

Rein-Arithmetischer Beweis des Siegelschen Endlichkeitssatzes für Binäre Diophantische Gleichungen im Spezialfall des Geschlechts 1. Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin, Klasse für Mathematik und allgemeine Naturwissenschaften, Jahrgang 1951, No. 2. Helmut Hasse. 18 pp. DM. 2. ***Neue Geologische Forschungen im Ural in Ihrer Grundsätzlichen Bedeutung.*** No. 3. Serge Von Bubnoff. 18 pp. Illus. DM. 3. Akademie-Verlag, Berlin, 1952.

Technical Papers

Dissociation of Chick Embryo Cells by Means of a Chelating Compound

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A number of recent investigations have involved the dissociation of the component cells of an embryo or organ rudiment (*1–5*). The dissociative agents have been high *p*H (*1, 4*), tryptic action (*2, 5*), or mechanical grinding (*3*). In two current problems, we found that the chelating compound di-sodium ethylene diamine tetraacetic acid—di-sodium versenate (*6*)—is very effective for dissociating cells from chick embryos (*7*).

One of these problems involves the dissociation of entire definitive primitive-streak-stage chick embryos into a suspension of cells. This is accomplished on a fairly large scale by the following procedure: The blastoderms are removed from the yolk, the area pellucida is dissected free in Tyrode's solution and then washed in three or four changes of Moscona's (*2*) Ca- and Mg-free solution. The blastoderms (six to eight in number) are then pipetted into 15-ml centrifuge tubes containing 2 ml of the versenate solution (100 mg percent, made up in Moscona's solution) which has been brought to approximately *p*H 8.5 with 0.4 ml of 1-percent KOH. After 20 to 30 min incubation at 37.5°C, the centrifuge tubes are agitated with a rotating motion. This agitation converts the blastoderms into a suspension of cells very rapidly. These cells may then be compacted by mild centrifugation, washed in Moscona's solution, and, again following centrifugation, resuspended in a standard tissue-culture medium (horse serum, Tyrode's solution, and embryo extract, in the proportions 2 : 2 : 1).

Microscopic examination prior to the last step reveals that the majority of cells are completely free and that the largest clumps contain only three or four cells. Very few of the cells show any visible indication of damage. Cells suspended by this procedure reaggregate in the culture medium. When such aggregates are kept in depression slides, they regularly form healthy cultures, which spread over the glass surface and live for at least 2 or 3 days. In a few instances, some of the larger aggregates have been placed on the chorioallantoic membranes of appropriate chick embryo hosts. They have yielded healthy, growing grafts.

In the second problem, we found it desirable to remove the ectoderm from the limb buds of 3-day chick embryos. The object was to leave the mesoderm as unaltered as possible. Trypsin skinning (*2*) was not appropriate for this work. It was found that the following procedure yields limb-bud mesenchyme which is firm and amenable to further manipulation: The limb buds are removed from the embryo surgically in Tyrode's solution, washed in three or four changes of Moscona's solution, and then placed in the versenate solution described in a foregoing paragraph (alkali not added). After 20 to 30 min at 37.5°C, the ectoderm is sufficiently macerated so that it can be scraped off (a longer sojourn in the versenate solution, especially at higher *p*H, results in the dissociation of the mesenchyme). This leaves the limb-bud mesenchyme smooth and firm and, after washing in Tyrode's solution or Tyrode's solution and horse serum (1 : 1), viable.

These observations suggest that di-sodium ethylene diamine tetraacetic acid may be a very useful adjuvant for other biological procedures that require Ca- and Mg-free solutions.

References and Notes

1. J. Holtfreter, *Symposia Soc. Exptl. Biol.* **2**, 17 (1948).
2. A. and H. Moscona, *J. Anat.* **86**, 287 (1952).
3. P. Weiss and G. Andres, *J. Exptl. Zool.* **121**, 449 (1952).
4. S. Mookerjee, *Nature* **171**, 796 (1953).
5. G. S. St. Amand and S. R. Tipton, *Science* **119**, 93 (1954).
6. Kindly supplied by the Bersworth Chemical Co., Framingham, Mass.
7. This investigation was supported in part by a research grant [C-1790 (R)] from the National Cancer Institute of the National Institutes of Health, U.S. Public Health Service.

4 March 1954.

Crystalline Neoretinene b

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We have prepared, in crystalline form, the isomer of vitamin-A aldehyde, which Hubbard and Wald (*1*) have called neoretinene b and identified as the precursor *in vivo* of the visual pigment rhodopsin. In this preliminary report (*2*) we describe the method of concentration and crystallization of the isomer, its physical properties, and its reduction to the corresponding vitamin-A isomer.

The preparative procedure was as follows: A solution of crystalline, all-trans vitamin-A aldehyde (4.0 g) in ethanol (1000 ml in a 1000-ml flask) was exposed for 4 hr to bright sunlight (outdoors, midsummer), filtered through a combination of Corning Nos. 3966 and 3850 filters. Alternatively, three photoflood lamps (No. 2), at a distance of 8 in. from the solution, were used as the light source, with the same filters, for an exposure time of 8 hr. These procedures proved to be preferable to the method used by Hubbard and Wald (*1*) for preparing larger amounts of the new isomer.

After removing the alcohol by distillation under reduced pressure, the residual mixed vitamin-A aldehyde isomers were dissolved in petroleum ether (bp 30° to 60°C) and chromatographed on a column (2 by 24

in.) of sodium silico-aluminate (400 g) (*3*). The column had been previously washed with 10 percent aqueous acetone (250 ml) to remove any free alkali and then with petroleum ether (500 ml) to remove acetone. The chromatogram was developed with petroleum ether to give first a nearly colorless filtrate (500 ml, 0.11 g), followed by a yellow-colored filtrate (1000 ml). The latter fraction gave, after removal of solvent by distillation under reduced pressure, a concentrate of neoretinene b (1.2 g, E(1 percent, 1 cm) (254, 375 mμ) = 445, 1115.

When this concentrate, in petroleum ether (2 ml), was cooled to −18°C, crystals were obtained (0.6 g) that consisted of neoretinene b mixed with some neovitamin-A aldehyde [neoretinene a (*1*)]. The orange prisms of neoretinene b were separated manually from the yellow needles of neovitamin-A aldehyde and were recrystallized from petroleum ether.

The neoretinene b thus prepared had mp 63.5° to 64.4°C and E(1 percent, 1 cm) (255, 376 mμ) = 595, 857 (ethanol, Cary instrument, Fig. 1). The ratio of the absorption at the so-called "cis" peak at 254 mμ to that at the main absorption maximum (376 mμ) was 0.69. Wald kindly arranged for a test on a sample of the crystals by incubation with opsin and confirmed its identification as neoretinene b.

Hubbard and Wald (*1*) have described the concentration of neoretinene b and the preparation of some crystalline material, but the amount was reported to be too small to determine its extinction coefficient. It was found to have an absorption maximum at 377.5 mμ (ethanol) and an extinction coefficient estimated to be between 900 and 1000. Its "cis" peak ratio was about 0.5. By private communication, Wald has indicated that other highly purified, although noncrystalline, preparations have subsequently been made in his laboratory.

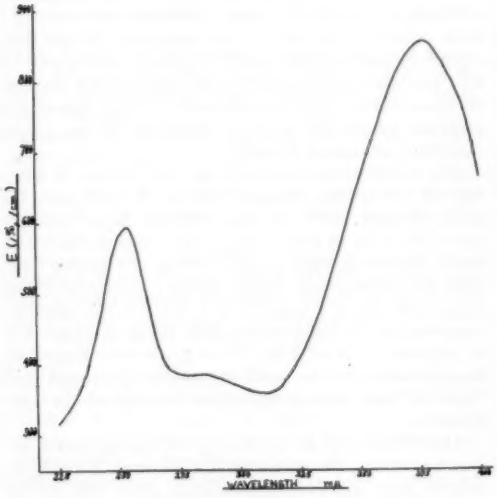

Fig. 1. Spectrophotometric curve of neoretinene b.

Neoretinene b was reduced with both lithium aluminum hydride and sodium borohydride to give the corresponding vitamin A. The absorption curve of a noncrystalline preparation, made by reduction of the aldehyde with lithium aluminum hydride, had a rather broad maximum with E(1 percent, 1 cm) (322 mμ) = 940 (ethanol) and a subsidiary maximum at 233 mμ having E(1 percent, 1 cm) = 270. From the data on the corresponding vitamin-A aldehyde isomers, it was expected that the extinction coefficient of this vitamin-A isomer [temporarily called neovitamin Ab (*1*)] would be substantially lower than that of all-trans vitamin A E(1 percent, 1 cm) (325 mμ) = 1830. Crystallization experiments on the isomer are in progress.

A preliminary bioassay by our biochemistry department, using the rat liver-storage method, has indicated that neoretinene b has about half the biological potency of all-trans vitamin-A aldehyde. Thus, this bioassay method does not reflect the biological importance that neoretinene b is considered to have in the formation of the visual pigment rhodopsin. The bioassay work will be described in a separate publication from these laboratories.

We are grateful to R. H. Delaney for technical assistance during the early work on this problem and to A. P. Besancon and assistants of these laboratories for the ultraviolet spectrographic measurements.

References and Notes

1. R. Hubbard and G. Wald, *J. Gen. Physiol.* **36**, 269 (1952).
2. Communication No. 202 from the Research Laboratories, Distillation Products Industries, Division of Eastman Kodak Co., Rochester, N.Y.
3. Doucil from Philadelphia Quartz Co.

8 March 1954.

The Radical Dissociation of Aryldisulfides

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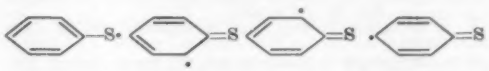
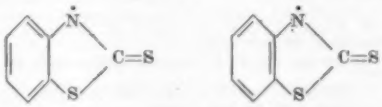
A considerable time ago (*1–3*) I investigated the problem of the dissociation of simple aryldisulfides, such as phenyldisulfide, into radicals with monovalent sulfur. In these studies I concluded that the investigated aryldisulfides do not undergo a *reversible* dissociation into *long-life* radicals. Later, Schönberg, Rupp, and Gumlich (*4*) reached the contrary conclusion, based partly on a different interpretation of my experiments and partly on new experimental data furnished by Schönberg and his associates. Schönberg's views have been shared by several subsequent authors (*5–7*). Considering the theoretical importance of the problem indicated, a review of existing data has been made and additional experimental evidence has been obtained supporting a position that differs from that of Schönberg and his followers.

1) We do not know all the factors that cause the formation and relative stability of long-life organic

radicals. However, from what we do know, we must conclude that the existence of long-life aromatic sulfenyl radicals, such as $C_6H_5S\cdot$, is very improbable. There is no steric influence and the resonance possibilities are restricted to only four canonical structures:



2) Unfortunately, we know nothing about the paramagnetic susceptibility of aryldisulfides. Cutforth and Selwood (*8*) have found that 2,2′-dithiobisbenzothiazole is paramagnetic in toluene solution above 100°C. They assume that the free radicals are formed through dissociation at the sulfur-sulfur bond but state that the magnetic results do not prove such dissociation; excitation to a triplet state would yield comparable results. At any rate, this compound is not an aryldisulfide and any radicals formed by dissociation of the S—S link have more possible canonical structures than aryl S· radicals have, two of them with bivalent nitrogen (*9*):



This disulfide shows a surprisingly weak thermochromism.

3) The so-called "long-life" organic radicals have only a short life-span at elevated temperature where they decompose and generally disproportionate. However, phenyldisulfide for which Schönberg, Rupp, and Gumlich (*4*) postulated a radical dissociation at 100°C can be distilled at 190° to 192°C (15 mm) (*10*) without decomposition. This boiling point shows the proper relationship to the boiling point of phenylmonosulfide, 157° to 158°C (16 mm) (*11*). The disulfide can be heated in benzene solution in the dark at 200°C for 6 hr without decomposition (*3*). At a sufficiently high temperature any organic compound will break down, and it was to be expected that then phenyldisulfide would dissociate at its weakest link—that is, the S—S bond, with formation of *short-life* radicals. Schönberg and Mustafa (*12*) found that phenyldisulfide decomposes and disproportionates at 270°C. However, this high temperature formation of short-life radicals furnishes no support for the assumption of the existence of long-life radicals at a temperature 170° lower.

4) Schönberg, Hauptmann, their coworkers, and I have all described various reactions in which the S—S bond of aromatic disulfides is split by reactants such as triphenylmethyl (*1*), diphenyldiazomethane (*13*), triphenylphosphine (*14*), metals (*1, 4, 15*), and sodium ketyls (*4*). However, this circumstantial evidence of the presence of sulfur radicals is of dubious value. As a matter of fact, in one specific case (*3*) I furnished experimental proof that the reaction with the metal proceeds in the absence of such preformed radicals. On the other hand, it is quite possible, and in some cases probable, that aromatic disulfides will form short-life radicals under the impact of other radicals or metals.

5) The thermochromism of aryldisulfides (*1*) which plays such an important part in Schönberg's arguments and particularly in Mustafa's and Kamel's recent paper (*7*) must be considered. The phenomenon that compounds reversibly change their absorption and color with rising and falling temperature is a very common one and may have various causes, sometimes trivial ones. Although it is correct to state that a reversible dissociation into long-life colored radicals is accompanied by thermochromism, the reverse conclusion would be untenable. Colored aryldisulfides also show their thermochromism in the crystalline state (*1*) where a dissociation equilibrium is highly improbable. Frequently thermochromism is the precursor of a dissociation occurring at a higher temperature (*2, 16*). I have shown (*2*) that the mercury salts of benzenethiol and of 4-dimethylamino-benzene-thiol are thermochromic in solid and dissolved state; in this case the dissociation into the disulfide plus mercury manifests itself by the appearance of the metal at a temperature above the range within which thermochromism is conspicuous.

6) Piccard (*17*) has shown that a reversible dissociation into colored radicals can be demonstrated by the fact that *Beer's law* is not obeyed. Schönberg, Rupp, and Gumlich (*4*) stated that solutions of phenyldisulfide in ethylene bromide, in anisole, and in naphthalene do not obey this law at 100°C. The alleged invalidity of Beer's law has been regarded as an unequivocal proof of the existence of long-life sulfur radicals. However, I had previously found (*1*) that xylene solutions of phenyldisulfide of approximately the same concentrations as used by Schönberg, Rupp, and Gumlich do obey Beer's law at 130°C. When recent experiments by Kharasch, Nudenberg, and Meltzer (*18*) made the existence of long-life benzene-sulfenyl radicals at 100°C very improbable, the validity of Beer's law was reinvestigated with modern spectrophotometric equipment (*19*). Anisole solutions of phenyldisulfide in a concentration range even greater than that used by Schönberg, Rupp, and Gumlich were used, and it was found that within the limits of error Beer's law is valid at 100°C. With this result, the only strong experimental support for Schönberg's theory becomes void.

For maintaining the solution in the cell at an elevated constant temperature, we used an instrument described by Kienle, Royer, and McCleary (*20*). (Although it was originally designed for a different purpose, this instrument proved to be very well suited for this investigation.) A comparatively large volume of solution is heated, with thermostatic control (±0.5°) in a separate chamber and is circulated at great speed (complete circulation, 7 to 12 sec) through the cell.

The measurements were carried out with the modified (*21*) Hardy-type (*22*) recording spectrophotometer in the range of 4000 to 7000 A. The molar absorptivity ε (molar

extinction coefficient) was calculated according to the equation

$$\varepsilon = \log_{10}(1/T)/bc,$$

where T is the transmittance (the ratio of the radiant power transmitted through the solution to the radiant power transmitted through the solvent), b is the length of the cell path (0.75 cm), and c is the concentration in moles per liter. We chose the wavelength of about 4100 A, at which Schönberg, Rupp, and Gumlich reported the greatest deviation from Beer's law. (Table 1.)

The limits of error in determining ε are estimated to be about ± 10 percent. The average value for ε at 100°C was 6, while Rupp reported a very considerable increase on dilution in an even smaller concentration range than the one used in the present work. The absorption curves were straight lines and did not show the peak characteristic of free organic radicals.

7) The formation and the reactions of short-life radicals of the type RS have been extensively investigated during the past 15 years. Disulfides form such radicals under the influence of irradiation, peroxides, and/or alkyl radicals. They are exceedingly reactive and initiate chain reactions, resulting in the "abnormal" addition of thiols to double bonds, polymerizations, redistributions of RS groups, and so forth. In investigating the formation of short-life radicals from disulfides, Kharasch, Nudenberg, and Meltzer (*18*) have made an important contribution to the problem of long-life sulfenyl radicals. They investigated under which conditions disulfides form short-life radicals which initiate the addition of mercaptans to double bonds and the polymerization of butadiene-styrene. They found that the disulfides, among them phenyldisulfide, had no effect in the dark. Even at 90°C, phenyldisulfide did not catalyze the addition of lauryl mercaptan to styrene, but irradiation greatly increased the rate of this addition. The emulsion copolymerization of butadiene-styrene at 50°C was not catalyzed by p-anisyldisulfide in the dark but was very much so upon irradiation. The obvious conclusion from these experiments is that up to at least 90°C phenyldisulfide does not form long-life radicals, but it does form short-life radicals on irradiation. If phenyldisulfide would reversibly dissociate at 100°C to such an extent that Beer's law would not hold, as Schönberg maintained, the C_6H_5S radicals should initiate Kharasch's reactions in the dark.

8) The present correct nomenclature of radicals RS is *sulfenyl* radicals (*23*) (derived from RSOH, sulfenic acids). Other names used by various authors, such as *thiol radicals, thiyls, mercaptide radicals, thioalkyls* and *thioaryls,* and *mercaptyls,* are awkward and incorrect.

Table 1. Phenyldisulfide in anisole.

c (10^{-4} mole/lit)	ε, Kodama, 100°C	ε, Rupp, 100°C (*4*)
0.6	5.6	
1.25		4.1
1.3	5.9	
2.5	6.4	3.2
10.0	6.4	1.6

In conclusion the experimental and theoretical evidence available at present speaks strongly against the dissociation of aryldisulfides into long-life sulfenyl radicals.

References and Notes

1. H. Lecher, *Ber.* **48**, 524 (1915).
2. ———, *Ber.* **48**, 1425 (1915).
3. ———, *Ber.* **53**, 577 (1920).
4. A. Schönberg, E. Rupp, and W. Gumlich, *Ber.* **66**, 1932 (1933).
5. A. Schönberg, A. Mustafa, and W. Askar, *Science* **109**, 522 (1949).
6. D. A. Shirley and P. A. Roussel, *Science* **113**, 208 (1951).
7. A. Mustafa and M. Kamel, *Science* **118**, 411 (1953).
8. H. G. Cutforth and P. W. Selwood, *J. Am. Chem. Soc.* **70**, 278 (1948).
9. C. G. Moore, *J. Chem. Soc.* **1952**, 4232.
10. F. Krafft and W. Vorster, *Ber.* **26**, 2813 (1893).
11. W. Dilthey *et al., J. prakt. Chem.* [2] **124**, 81 (1930).
12. A. Schönberg and A. Mustafa, *J. Chem. Soc.* **1949**, 889.
13. A. Schönberg, O. Schütz, and J. Peter, *Ber.* **62**, 440 (1929).
14. A. Schönberg, *Ber.* **68**, 163 (1935); A. Schönberg and M. Z. Barakat, *J. Chem. Soc.* **1949**, 892.
15. H. Hauptmann and B. Wladislaw, *J. Am. Chem. Soc.* **72**, 707, 710 (1950); H. Hauptmann *et al., Ann.* **576**, 45 (1952).
16. W. Biltz, *Z. anorg. Chem.* **127**, 181 (1923).
17. J. F. Piccard, *Ann.* **381**, 347 (1911).
18. M. S. Kharasch, W. Nudenberg, and T. H. Meltzer, *J. Org. Chem.* **18**, 1233 (1953).
19. These experiments were performed by S. P. Kodama of the photometric laboratory of American Cyanamid Co.
20. R. H. Kienle, G. L. Royer, and H. B. McCleary, *Textile Research J.* **16**, 616 (1946).
21. R. H. Kienle and E. I. Stearns, *Instruments* **20**, 1057 (1947).
22. A. C. Hardy, *J. Opt. Soc. Amer.* **25**, 305 (1935); J. L. Michaelson, *ibid.* **28**, 365 (1938).
23. *Chemical Abstracts* **39**, 5892, 5898 (1945).

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The Isolation and Identification of "Bound" Morphine

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Gross and Thompson (*1*), for the dog, and Oberst (*2, 3*), for the human being, found that morphine was excreted in the urine, not only in the free form, but also in a combined form. Because other substances with either a phenolic or alcoholic hydroxyl group are excreted as glucuronides, it was suggested that morphine might also be excreted in this form. When the idea was tested (*3*) by measuring the concentration of glucuronic acid in hydrolyzed urine after increasing doses of morphine, the concentration was found to increase proportionally. Thus, it was concluded that probably morphine was "bound" with glucuronic acid.

Since the time of appearance of the afore-mentioned references (*1–3*), no additional specific identification of "bound" morphine has been made. This paper (*4*) reports on the isolation and identification of the conjugated morphine.

An 11-kg dog was anesthetized and infused with 4 g

of morphine sulfate during a 3-hr period. A total of 110 ml of urine was collected during this period and the succeeding 3 hr. The total urine collected was treated with urease to remove urea and then evaporated to a small volume. The concentrated urine was chromatographed on Whatman No. 1 paper, using an n-butanol, acetic acid, water solvent of 10-3-4.5 ratio. The sheets, when sprayed with Munier's alkaloid reagent (*5*), showed a spot with an Rf of 0.16 to 0.20 and a spot at an Rf of 0.55 to 0.60 [Fig. 1(2)]. This higher spot corresponds to known morphine [Fig. 1(1)]. The area with an Rf of 0.16 to 0.20 was cut from the paper, and this strip was placed in a Soxhlet apparatus. The paper was extracted by refluxing with absolute methanol to remove alcohol-soluble impurities and then eluted by refluxing with distilled water. Chromatographing of the water eluate indicated a reasonably pure substance. However, the material obtained by evaporating the water eluate was recrystallized twice from methanol-water mixture and rechromatographed [Fig. 1(3)].

Hydrolysis of the pure compound obtained from the water eluate was attempted in the following ways: with β-glucuronidase for 24 hr at 37°C at a *p*H of 5.0; and by autoclaving in 1.0*N* HCl at 15 lb for 20 min. Each of these solutions was placed on paper in duplicate, one sheet being sprayed with Munier's alkaloid reagent [Fig. 1(5, 6)] and the other being sprayed with aniline phthalate sugar spray [Fig. 2(1, 2)].

All hydrolyzed solutions treated with the alkaloid reagent gave a spot that is identical with the Rf of known morphine [Fig. 1(1, 5, 6)] and, when sprayed with the sugar reagent, gave three spots with Rf

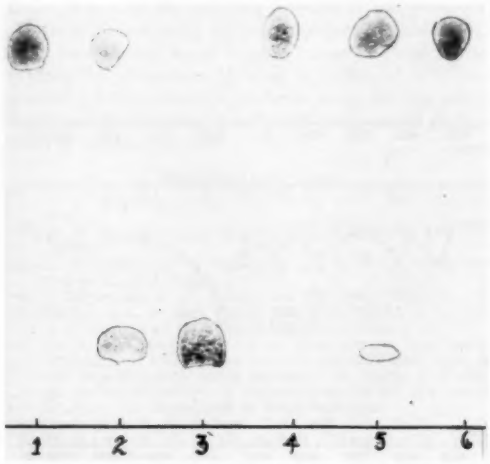

Fig. 1. (1) Known morphine. (2) Urine of morphinized dog showing spots with Rf 0.16 to 0.20 and Rf 0.55 to 0.60. (3) Low Rf spot after separation from high Rf. (4) High Rf after separation. (5) Low Rf material after hydrolysis with 1.0*N* HCl in autoclave. (6) Low Rf hydrolyzed with β-glucuronidase.

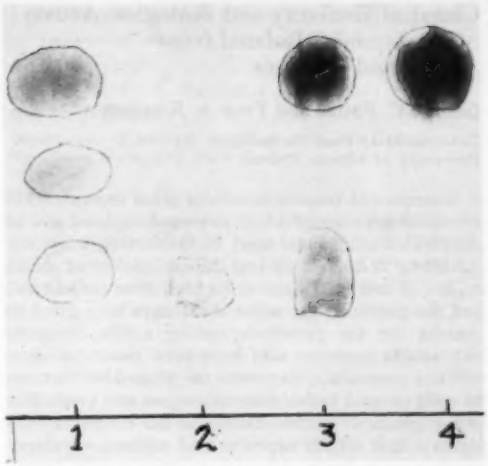

Fig. 2. (1) Low Rf substance autoclaved with 1.0*N* HCl. (2) Low Rf hydrolyzed with β-glucuronidase. (3) Known glucuronolactone heated with 0.1*N* HCl. (4) Known glucuronolactone untreated.

values of 0.16, 0.27, and 0.32. The spots with an Rf of 0.32 correspond to known glucuronolactone [Fig. 2(4)], and the spot with an Rf of 0.16 corresponds to known glucuronic acid [Fig. 2(3)]. The hydrolysis with β-glucuronidase carried out on a small scale gave only one spot that has the same Rf as glucuronic acid [Fig. 2(2)]. The identity of the middle spot (Rf of 0.27) is still unknown. Also, a portion of the acid hydrolyzed material gave a typical naphthoresorcinol test for uronic acids.

The free morphine that was present in the urine was characterized by its Rf value, which corresponded to that of known morphine. Also, the material with an Rf of 0.55 to 0.60 was eluted with distilled water, the water eluate was saturated with sodium bicarbonate, and the crystals were collected by filtration. Solution of these crystals and chromatographing gave Fig. 1(4). On recrystallization, the material melted at the same temperature as that of a known morphine base, and a mixed melting point proved them to be identical. Further, picrates of both morphine and the unknown substance melted at the same temperature, as did a mixture of the two picrates.

It is evident from these data that the excretion product of morphine is a glucuronide, the structure of which is now under investigation.

References

1. E. G. Gross and V. Thompson, *J. Pharmacol. Exptl. Therap.* **68**, 413 (1940).
2. F. W. Oberst, *ibid.* **69**, 240 (1940).
3. ———, *ibid.* **73**, 401 (1941).
4. Work supported in part by a grant from the Houston Heart Association.
5. R. J. Block *et al.*, *Paper Chromatography. A Laboratory Manual* (Academic Press, New York, 1952).

1 March 1954.

Chemical Similarity and Biological Activty of the Saponins Isolated from Alfalfa and Soybeans

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A number of reasons have been given to explain the growth-depressing effect of uncooked soybean and of dehydrated alfalfa leaf meal. In the former, a trypsin-inhibiting factor (*1, 2*) and the availability of amino acids (*3*) and in the latter, its high fiber content (*4*) and the presence of a saponin (*5*) have been given as reasons for the growth-depressing action. Recently (*6*) alfalfa saponins also have been shown to cause bloat in ruminants. Saponins are glycosides that can be split on acid hydrolysis into sugars and crystalline saponogenins or genins. Studies in our laboratory (*7*) indicate that alfalfa saponins and soybean soyasapogenols are similar in chemical structure and biological activity.

At least three triterpene genins were isolated from dehydrated alfalfa leaf meal. Meal of weight 7.4 kg was extracted twice with hot 95 percent ethanol, the extract was freed from solvent, and the saponins were isolated and hydrolyzed by the procedure of Wall (*8*). The resulting 900-mg mixture of genins was dissolved in benzene and passed through a 2 by 12-cm column of alumina. The column was washed with 700 ml of benzene and extruded and divided into three equal portions. The top portion (section I), upon elution with 20 percent methanol in benzene and removal of the solvent, left a solid of 500 mg that had a melting point of 247° to 248°C and a specific rotation of +59°. The eluate from the middle portion (section II) contained 11 mg of solid, mp 285° to 286°C, and the bottom portion (section III) contained 30 mg of material, mp 233° to 235°C. When the material from section I was recrystallized from methanol, its melting point was raised to 258° to 259°C and its specific rotation to +88.7°. All the alfalfa genins gave a bright red turning to a deep red color on treatment with Liebermann-Burchard reagent, suggesting a triterpene nucleus. In analysis of section I for $C_{30}H_{50}O_3$, we calculated C, 78.55; H, 10.99; we found C, 76.87; H, 10.84. The materials were sublimed under high vacuum before analysis.

Ochiai *et al.* (*9*) isolated a series of sapogenols from soybeans. Soyasapogenol B had a melting point of 259°C and a specific rotation of +92.4. The soyasapogenol B isolated by Meyer *et al.* (*10*) had a melting point of 259° to 260°C and a specific rotation of +90°. In analysis of soyasapogenol B for $C_{30}H_{50}O_3$,

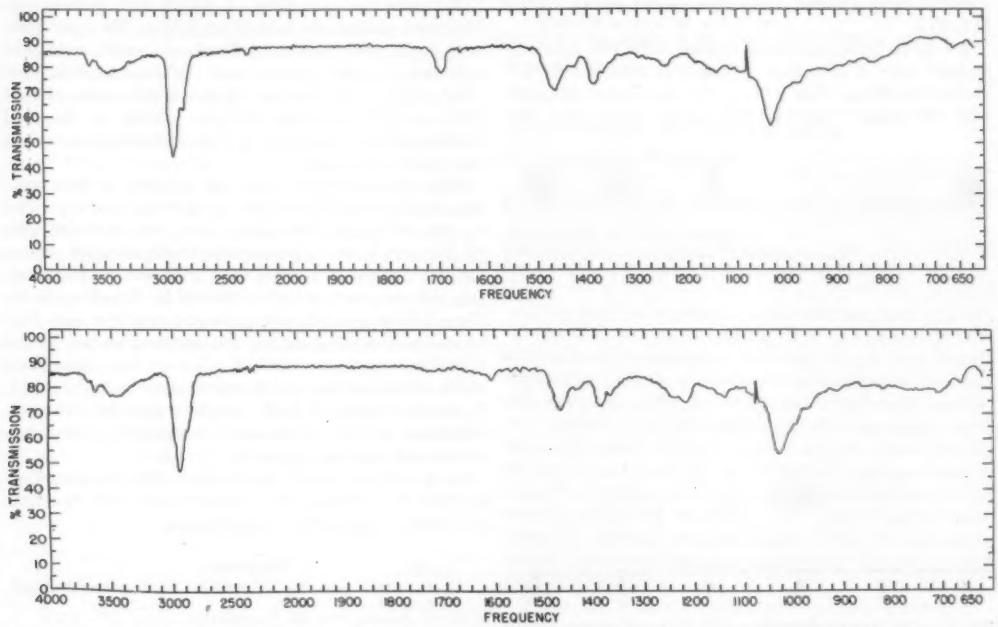

Fig. 1. The upper curve represents the infrared spectrum of the alfalfa genin, mp 258° to 259°C; the lower curve represents the spectrum of soyasapogenol B prepared in our laboratory. A Perkin-Elmer model 21 double-beam spectrophotometer with a sodium chloride prism and cell and solutions of 2.5 percent genin in chloroform were used to obtain both curves. The absorption at 1680 cm^{-1} in the upper curve was probably due to a small amount of carbonyl-containing material. The amount present was too small to give a positive Lappin and Clark test (*12*).

we calculated C, 78.55; H, 10.99; we found C, 78.48; H, 10.99.

A sample of soyasapogenol B was prepared in our laboratory according to the method given by Ochiai *et al.* It had a melting point of 257° to 258°C and a mixed melting point with the alfalfa genin I of 255° to 256°C. Infrared data (*11, 12*) indicated closely related structures for the two materials (Fig. 1). It is therefore suggested that the neutral saponins of alfalfa are of the same type as the neutral saponins of soybean in that both contain a triterpene nucleus in the aglucon portion (Fig. 2).

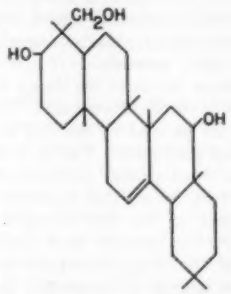

Fig. 2. The structure of soyasapogenol B, as given by Meyer *et al.* (*10*), appeared to be similar to the alfalfa genin, mp 258° to 259°C.

Both the purified alfalfa and soybean saponins inhibited the growth of chicks while their genins did not (*13*). At least part of the growth-depressing effect of uncooked soybean meal may be due, therefore, to the soyasapogenols which on cooking hydrolyze to nontoxic genins. If this cooking process is too mild, incomplete hydrolysis of the soyasapogenols could occur. Such meals might cause bloat in ruminants and would explain the occurrence of bloat in cattle fed with untoasted solvent-extracted soybean meal. On the other hand, the dehydrating conditions are too mild to hydrolyze alfalfa saponin.

References and Notes

1. D. E. Bowman, *Proc. Soc. Exptl. Biol. Med.* **57**, 139 (1944).
2. W. E. Ham and R. M. Sandstedt, *J. Biol. Chem.* **154**, 505 (1944).
3. J. W. Hayward, H. Steenbock, and G. Bohstedt. *J. Nutrition* **12**, 275 (1936).
4. S. Lepkovsky *et al.*, *Poultry Sci.* **29**, 208 (1950).
5. D. Peterson, *J. Biol. Chem.* **183**, 647 (1950).
6. I. L. Lindahl *et al.*, *Science* **119**, 157 (1954).
7. Funds for partial support of these studies were made available by Armour and Co., Chicago, Ill. This work is also reported in a thesis presented by George C. Potter as partial fulfillment of the requirements for the degree of doctor of philosophy in food technology.
8. M. E. Wall *et al.*, *J. Biol. Chem.* **198**, 533 (1952).
9. E. O. Ochiai, K. Tsuda, and S. Kitagawa, *Ber.* **70B**, 2083 (1937).
10. A. Meyer, O. Jaëger, and L. Ruzicka, *Helv. Chim. Acta.* **33**, 672 (1950).
11. We are indebted to Noyes Laboratory of Chemistry for the infrared analyses.
12. G. R. Lappin and L. C. Clark, *Anal. Chem.* **23**, 541 (1951).
13. G. C. Potter and F. A. Kummerow, in preparation.

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Tumor Induction in *Drosophila melanogaster* by Injection of $e^{11}tu$ Larval Fluid

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Hereditary melanotic tumors have been reported in *Drosophila melanogaster* by numerous workers (*1–9*). The expression of these pigmented growths is modified by nutrition (*2, 3, 7, 10, 11*), temperature (*12, 13*), irradiation with x-rays (*6, 14–16*), available oxygen (*15, 16*), estrogen-like compounds (*17*), and carcinogens (*18*).

A hereditary pigmented tumor arose spontaneously in our ebony stock of *Drosophila melanogaster*. This hereditary tumor is determined by a gene (*tu*) on chromosome two at approximately locus 88 (*19*). Depending upon the food available to the larvae or the temperature experienced by the larvae, the frequency of tumorous adults (homozygous) varies from 26 to 90 percent (*10, 12*). X-rays applied at the proper developmental stage also modify the penetrance of the tumor gene (*14*). Initial transplantation experiments of the pigmented growth into larvae of a nontumor strain indicated tremendous growth and subsequent appearance of multiple pigmented bodies. These findings were similar to those reported by Russell (*8*).

Both host and donor larvae of 120 hr of age (from egg laying) were chosen as test animals, because of the high postoperative survival of host animals at this age. Repeated trials were made for each test. For each trial, 50 donor larvae of the desired stock were used in the preparation of the larval extract. The larvae were washed 3 times in Waddington's insect Ringer's solution, placed in a mortar, and ground to an amorphous mash in 8 drops of insect Ringer's solution. The mixture of mashed larvae and insect Ringer's was pipetted into a centrifuge tube and centrifuged at 5400 rev/min for 15 min. The acellular supernatant fluid was then transferred into a clean, cooled tube and immediately placed in an ice bath. The acellular nature of the fluid was regularly confirmed microscopically by smears. The ice bath was employed to delay a blackening of the fluid extract that invariably occurred with the passage of time. The blackened fluid was so toxic that no animal injected with it ever survived the operation.

The 120-hr-old larval hosts were washed in three consecutive baths of insect Ringer's solution, dried, and etherized. The injection apparatus utilized in this experiment was essentially the same as that described by Ephrussi and Beadle (*20*), except that needle tips of very small diameter were used to reduce mortality. The needle was inserted at about the third or fourth segment from the posterior end of the larva. Fluid was administered until the larva was slightly distended. The host larvae were then placed on moist filter paper until they had fully recovered from the anesthetic. Only active larvae that possessed a scar

Table 1. Response to larval extract injections.

Donor	Host	Larvae tested	Dead larvae	Dead pupae		Emerged No.	Adults tumorous
				No.	Tumorous		
e tu	wild	160	66	40	39	54	54
*e tu**	wild	173	51	88	0	34	0
e tu	*y w*	52	7	22	22	23	19
wild	*y w*	38	9	10	0	19	0
y w	wild	67	18	12	0	37	0

* *e tu* donor reared on 2.5-percent "dead" brewer's yeast.

in the body wall that had been formed from the clot caused by the insertion of the needle were transferred to fresh vials of food. All other larvae were discarded. Thereafter all animals were observed daily.

Larvae that failed to pupate were removed and recorded without reference to the possible presence or absence of tumors, since they might have died before a possible tumor agent could have operated. Animals that died in the pupal stage were dissected, and the presence of tumors was recorded. All adults were dissected, and the presence and number of observable tumors per animal were recorded.

Three genotypes were used. The wild 51–52 stock had been inbred by single-pair sib matings for 51 generations and subsequently for 52 generations. It is a uniform stock, and not one tumorous imago was observed in more than 10,000 reared at 25°C on standard food, dissected, and examined (*21*). A yellow body, white eye (*y w*) stock maintained by mass matings in our laboratory was a random selection from our stocks and was used as a second test line. The ebony tumor strain was the third genotype used.

Insertion of the empty needle into the larva produced an operational injury that constituted a control test of the induction of tumors, and pure insect Ringer's solution was injected as a check on its activity as a tumor-inducing agent. Nearly 100 larvae of the tumor-free strains were tested by each of these methods, and none developed tumors.

The results of body fluid injections (Table 1) demonstrate that a melanotic-tumor-inducing agent was present in the 120-hr-old larvae of the ebony tumorous strain. Though somewhat diluted in extraction, it induced tumors in 93 of 94 genetically nontumorous wild-type animals and in 41 or 45 genetically nontumorous yellow white animals that survived long enough after the injection for tumors to develop (that is, through metamorphosis). The number of tumors formed in the wild-type adult hosts ranged from 1 to 24 tumors per animal, with a mean value of 3.7 melanotic tumors per adult fly. Conversely, the larval fluids of the wild 51–52 and yellow white nontumorous strains did not contain a tumor-inducing agent (Table 1).

Although these two strains neither possessed the tumor-inducing agent nor developed tumors under normal conditions, their larval tissue was reactive to the tumor-inducing agent of the ebony tumorous stock. This must mean that the tumor gene on chromosome two is synthesizing or controlling the synthesis of this tumor-inducing agent. It is specific to larval tissue, since it is incapable of inducing tumors in imaginal disk tissue. The degree of its specificity—that is, the types of larval tissue reactive to it—is being determined by histological studies (*22*). Whether this specificity actually resides in the agent or in the tissue is not yet known. If, in our other tumor strains, the hereditary tumors developing in imaginal disk (imago) tissue are due to an inducing agent, then it must be one of a different nature, since no larval tissue tumors are formed in these animals.

When first instar larvae of the ebony tumorous stock were raised on a sterile 2.5-percent "dead" brewer's yeast medium, 26 percent of the 580 emerged adults showed the pigmented tumor. This is in direct contrast to the fact that when similar aged larvae of the same stock developed on the normal cornmeal-molasses medium, 83 percent of the 726 emerged adults were tumorous. Therefore, extracts were made of the 120-hr-old larvae of the ebony tumorous strain that had been reared on sterile 2.5-percent "dead" brewer's yeast medium. These extracts were injected, in a series of three trials, into 120-hr-old larvae of the nontumorous 51–52 strain (Table 1). None of the 114 host animals surviving to metamorphosis possessed melanotic growths.

Injection of extracts obtained from donor larvae of the ebony tumorous strain that had been reared on a normal cornmeal-molasses medium produced tumors in 93 of the 94 injected wild 51–52 host larvae. When donor larvae were reared on the 2.5-percent "dead" brewer's yeast medium, extracts from these animals were not capable of inducing tumors in the wild 51–52 host animals. These facts indicate that the tumor-inducing capacity of donor larval extracts is modified by the nutrition available to developing larvae of the ebony tumorous strain.

References

1. C. B. Bridges, *Genetics* **1**, 107 (1916).
2. H. M. Briones, *Biologica* **10/11**, 55 (1949).
3. W. J. Burdette, *Texas Repts. Biol. and Med.* **3**, 123 (1950).
4. S. Gheleiovitch, *Compt. rend. acad. sci.* **230**, 1002 (1950).
5. M. H. Harnly, E. D. Goldsmith, and F. Friedman, *Cancer Research* **9**, 604 (1949) abst.
6. E. W. Hartung, *Cancer Research* **2**, 837 (1942).
7. I. H. Herskowitz and W. J. Burdette, *J. Exptl. Zool.* **117**, 499 (1951).
8. E. S. Russell, *J. Exptl. Zool.* **84**, 363 (1940).
9. M. B. Stark, *J. Cancer Research* **3**, 279 (1919).
10. F. Friedman, M. H. Harnly, and E. D. Goldsmith, *Cancer Research* **11**, 904 (1951).
11. S. Gheleiovitch, *Compt. rend. acad. sci.* **232**, 1776 (1951).
12. G. C. Emery and M. H. Harnly, master's thesis, N.Y.U. (1951).
13. E. W. Hartung, *J. Exptl. Zool.* **108**, 223 (1947).
14. M. L. Fleischer and M. H. Harnly, master's thesis, N.Y.U. 21 (1954).
15. B. Glass and H. L. Plaine, *Proc. Natl. Acad. Sci. U.S.* **38**, 697 (1952).
16. H. L. Plaine and B. Glass, *Cancer Research* **12**, 829 (1952).
17. D. Brncic and S. Koref, *Science* **114**, 492 (1951).

18. W. J. Burdette, *Cancer Research* **12**, 366 (1952).
19. M. H. Harnly *et al.*, *Cancer Research* **11**, 254 (1951) abst.
20. B. Ephrussi and G. W. Beadle, *Am. Naturalist* **70**, 218 (1936).
21. L. Burton and M. H. Harnly, master's thesis, N.Y.U. (1953).
22. M. L. Kaplan and M. H. Harnly, master's thesis, N.Y.U. (1954).

13 April 1954.

Serologic Differences in Strains of Herpes Simplex Virus

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Previous serologic studies have yielded conflicting evidence on the occurrence of antigenic differences among strains of herpes simplex virus. In some cross-neutralization tests in mice (*1*) and in mouse and chick embryos (*2*), antigenic differences were considered to have been demonstrated. No serologic differences were noted, however, in the strains examined in other observations involving neutralization in chick embryos (*3, 4*) and in infant mice (*5*) or employing cross-complement fixation (*4, 6*). In none of these experiments did the number of strains tested exceed four.

Current opinion appears to favor the belief that strains of herpes virus are remarkably uniform in their serologic behavior. Nevertheless, puzzling immunologic behavior has been observed occasionally (*7, 8*), suggesting that antigenic dissimilarity of herpes strains may indeed exist.

Table 1. Cross-complement fixation titers with six strains of herpes simplex and their antiserums.

Antiserum vs.	Antigens					
	AS	AH	O'C	HF	RH	WG
AS	8*	4	8	0	0	0
AH	16	16	16	4	0	8
O'C	16	16	64	8	8	8
HF	8	8	8	8	0	4
RH	4	8	8	4	32	32
WG	0	0	4	0	8	32

* Reciprocal of serum titer.

In order to examine the latter possibility, immune serums were obtained from rabbits that survived corneal infection with 11 strains of herpes virus that had been adapted to growth in the chick embryo. Nine of these were adapted to the chick embryo following isolation in eggs and two (HF and O'C) were laboratory strains previously passed in rabbits or mice. All showed the usual biologic properties of herpes simplex virus, and all but three produced symptomatic encephalitis in the rabbit.

Cross-complement fixation tests have been carried out between six of these viruses and their antiserums. All antiserums were tested simultaneously against a single antigen. Antigens consisted of bacteriologically sterile amniotic fluids from chick embryos dying after yolk-sac inoculation. Their optimal dilution was determined by a grid titration (antigen dilutions versus serum dilutions) with the homologous antiserum. Two minimal hemolytic units of complement were used in the tests, which were completed after 18-hr over-night fixation at 4°C by the addition of sensitized cells. The end-point chosen was 3+ fixation (50 percent hemolysis). The usual controls for specificity of the reactions were carried out simultaneously with the tests.

The titers obtained in the cross serologic examination of the six strains are presented in Table 1. A calculation of 2-titer ratios (*9–11*) yields the values appearing in Table 2. A ratio of 50-percent similarity in strains (ratio ½) or greater indicates relative serologic identity of strains, and a relationship of less than 50 percent (ratio $< \frac{1}{2}$) is required for demonstration of serologic differences. It is evident that, even in this limited group of strains, striking antigenic differences obtain between the closely related strains AS and AH on the one hand and the closely related strains RH and WG on the other. The other two strains are intermediate in their relationships to these extremes. Recent studies by Jawetz *et al.* (*12*) support the view that antigenic dissimilarity in herpes strains has been clearly demonstrated.

Additional observations on the relationship of these strains to others are being carried out by cross-complement fixation tests, and cross-neutralization tests along similar lines are in progress.

References and Notes

1. H. B. Slavin and E. Gavette, *Proc. Soc. Exptl. Biol. Med.* **63**, 345 (1946).
2. A. L. Florman and F. W. Trader, *J. Immunol.* **55**, 263 (1947).
3. F. M. Burnet and D. Lush, *J. Pathol. Bacteriol.* **48**, 275 (1939).

Table 2. Cross antigenic relationships of six strains of herpes simplex. First figures refer to 2-titer antigenic ratios. Values in parentheses are percentages of relationship between strains.

	AS	AH	O'C	HF	RH	WG
AS	1 (100)					
AH	$\frac{1}{2.4}$ (71.4)	1 (100)				
O'C	$\frac{1}{2}$ (50.0)	$\frac{1}{2}$ (50.0)	1 (100)			
HF	$\frac{1}{2.8}$ (35.7)	$\frac{1}{2}$ (50.0)	$\frac{1}{2.8}$ (35.7)	1 (100)		
RH	$\frac{1}{8}$ (12.5)	$\frac{1}{8}$ (12.5)	$\frac{1}{5.7}$ (17.5)	$\frac{1}{8}$ (12.5)	1 (100)	
WG	$\frac{1}{15}$ (6.3)	$\frac{1}{8}$ (12.5)	$\frac{1}{8}$ (12.5)	$\frac{1}{8}$ (12.5)	$\frac{1}{2}$ (50.0)	1 (100)

4. M. E. Hayward, *Lancet* **1**, 856 (1950).
5. E. D. Kilbourne and F. L. Horsfall, Jr., *J. Immunol.* **67**, 321 (1951).
6. M. E. Hayward, *Brit. J. Exptl. Pathol.* **30**, 520 (1949).
7. E. Jawetz and V. R. Coleman, *J. Immunol.* **68**, 645 (1952).
8. C. R. Womack and C. C. Randall, *Am. J. Med.* **15**, 633 (1953).
9. Square root of the product of the ratio of heterologous to homologous titer obtained with each of two antiserums and the corresponding antigens.
10. C. M. Chu, C. H. Andrewes, and A. W. Gledhill, *Bull. World Health Organization* **3**, 187 (1950).
11. I. Archetti and F. L. Horsfall, Jr., *J. Immunol.* **92**, 441 (1950).
12. E. Jawetz, V. R. Coleman, and E. R. Merrill, *Federation Proc.* **13**, 498 (1954).

29 March 1954.

Nonmarine Miocene Arthropods from California*

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An excellently preserved fauna consisting mostly of fossil insects, arachnids, and branchiopods has been discovered in lacustrine deposits of middle Miocene or older age in the Calico Mountains, Mojave Desert, California. The composition of the fauna secured to date is shown in Table 1. Most of the specimens except the dragonfly nymphs, which are 18 mm long, have a maximum dimension of less than 3 mm.

The insects are preserved in petroliferous limestone nodules associated with bedded borates. At least three modes of preservation have been observed.

The dragonfly nymphs are preserved in calcite, the remainder of the specimens are preserved either in silica or in apparently only slightly altered organic material. Most of the specimens are uncrushed, and the quality of the preservation is such that hairs on the body and appendages are preserved. Figure 1 illustrates some of the detailed characteristics that are preserved.

* Publication authorized by the Director, U.S. Geological Survey.

Fig. 1. Ventral view of a silicified adult midge. (×20)

The dragonfly nymphs were almost completely enclosed within limestone nodules when found. They have been excavated with a fine chisel-edged needle. The remainder of the specimens have been obtained from insoluble residues of limestone nodules digested in formic acid. Neither the organic nor the siliceous material appears to be affected by this acid. Most of the specimens are completely free of enclosing sediment and may be treated for study in much the same way as modern specimens.

Calcareous nodules in other fresh-water lake deposits of the Tertiary period should be examined for insect material. If additional specimens found at other localities are comparable in quality to those already discovered, the relatively unexploited field of stratigraphic paleoentomology may become a valuable tool in the study of the Tertiary lake deposits of western United States. In cooperation with entomologists of the U.S. Department of Agriculture and some universities, we are presently engaged in the study and description of the geologic and biologic implications of the insect fauna outlined in this paper.

The locality from which the insects have been collected is in the southeastern Calico Mountains about 5 mi north of Yermo and 1500 ft east of the Mule Canyon road, in the NE¼ NW¼ sec. 25, T. 10 N., R. 1 E., San Bernardino Meridian, Mojave Desert, California.

The geology of the Calico Mountains has been mapped recently by Thane H. McCulloh of the U.S. Geological Survey. He has divided the Tertiary section in the vicinity of the insect beds into four major lithic units:

4) Fluviatile and lacustrine sandstone, siltstone, mudstone, limestone, and conglomerate (1000+ ft).

3) Massive resistant hornblende andesite flow breccia (0 to 500 ft).

2) Thin- to medium-bedded lacustrine sandstone, siltstone, and shale containing numerous limestone beds in the lower half and gypsum, howlite, and colemanite beds locally near the top (900 to 1100 ft); the fossil insects are found near the top of this unit.

Table 1. Composition of the fauna.

Kind of fossil	Aquatic	Non-aquatic	Approx. No. of specimens	Approx. % of fauna
May-fly nymph	x		1	< 1
Dragonfly nymph	x		4	1
Thrips		x	17	5
True bug (3 species)		x	4	1
Beetle larva	x		130	30
Midge (2 species)			100	25
Larva	x		(23)	(6)
Pupa	x		(55)	(15)
Adults		x	(14)	(4)
Mite (2 species)		x	6	> 1
Spider		x	2	< 1
Fairy shrimp	x		150+	35

1) Tuffaceous sandstone, tuff, tuff breccia and volcanic mudflow deposits (5000 to 10,000 ft), resting on varied pre-Tertiary rocks.

These four units are conformable in this area, although there is an unconformity at the top of the lowest unit, 1, a few miles to the west.

The only diagnostic fossils so far found in the afore-described Tertiary section are in unit 4. Mammals of early late Miocene age have been identified by G. Edward Lewis from the upper part of the unit, and late middle (?) Miocene mammals occur near the base. Since the insect-bearing beds lie in unit 2, conformably under these Miocene beds, they also are believed to be of Miocene age.

The limestone nodules are associated with the borate beds and occur in brown paper-thin shales, laminated siltstones, and thin limestone beds that weather to gray and buff colors and form badlands beneath the cliff-forming andesite flow breccia. The nodules range from a fraction of an inch to several inches in diameter and are generally spheroidal, but some are flatter parallel to the stratification, and some have a small central depression on the top surface. Microscopic examination of crushed nodules indicates that they are composed of finely crystalline calcium carbonate with a minor amount of dark oily material.

15 June 1954.

Inhibition of Virus Infections of Certain Plants by Extracts from *Capsicum frutescens* L.*

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The transmission and ready identification of viruses from certain plant genera and species are rendered difficult or impossible because of the presence of substances in extracts of these plants that inhibit the infection of indicator and other hosts. Extracts from *Phytolacca* (*1–3*), Dianthus (*4*), cucumber (*5*), and a number of chenopodiaceous plants (*6, 7*) contain such inhibitive substances. The paucity and sometimes the complete absence of characteristic symptoms following the mechanical inoculation of certain indicator hosts with juice expressed from sweet pepper plants (*Capsicum frutescens* L.) infected with cucumber mosaic and tobacco etch viruses indicated the existence of an inhibitor in pepper.

When juice expressed from the leaves of pepper plants infected with cucumber mosaic virus (CMV) was rubbed on the primary leaves of cowpea that had been lightly dusted with carborundum, one or two discrete, reddish, local lesions developed occasionally, and frequently no lesions appeared. The same results were obtained when the inoculum was obtained from recently infected pepper plants and from those showing long-standing infections. In contrast, however, inoculum obtained from infected burley tobacco plants yielded large numbers of local lesions on every inoculated leaf of cowpea. The results of five separate tests in which the extract from infected pepper was compared with an extract from infected tobacco gave an average of 0.4 lesions from the former and 150.6 from the latter. Three different isolates of CMV yielded essentially similar results. Furthermore, inoculations on *Chenopodium hybridum* L., another local lesion host for this virus, yielded correspondingly similar results.

Other infectivity tests were conducted in which CMV juice expressed from tobacco was adulterated with a few drops of healthy pepper extract. Assays of the adulterated and unadulterated juices were made on cowpea and *C. hybridum*. In six tests the average number of lesions per cowpea leaf was 7.9 for the former and 220.7 for the latter, and on *C. hybridum* the average number of lesions recorded was 10.2 following inoculation with the adulterated juice and 133.0 with the unadulterated juice.

As demonstrated by the local lesion response on cowpea, pepper extract was shown to be capable of reducing the infectivity of CMV, regardless of whether the virus was multiplied in *Nicotiana tabacum* L., *N. glutinosa* L., or in cucumber.

Other similar inoculations involving two different strains of ringspot virus isolated from tobacco and from cucumber showed that pepper extract almost completely inhibited the development of local lesions on cowpea and on *C. hybridum*. Moreover, the adulteration of infective juice of tobacco ringspot virus with a few drops of healthy pepper extract reduced local lesion production on tobacco.

In addition, other mechanical inoculations disclosed that the percentage of successful transmissions with tobacco etch virus by rubbing the leaves of cape gooseberry (*Physalis peruviana* L.) with juice expressed from infected pepper, as compared with that from tobacco, was relatively low. Furthermore, the adulteration of infective juice of the etch virus obtained from tobacco with a few drops of pepper extract decreased primary lesions on the inoculated leaves of burley tobacco by as much as 7 or 8 times.

Although assay tests indicated that the concentration of both cucumber mosaic and tobacco etch viruses in pepper was extremely low, nevertheless, in view of the afore-described evidence this may not be the true picture. The presence of virus inhibitors makes it necessary to exercise caution when estimating, by means of local lesion assays, the concentration of a virus in several different hosts.

References and Notes

* Contribution No. 1397 from the Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa, Canada.

1. S. P. Doolittle and M. N. Walker, *J. Agr. Research* **31**, 1 (1925).
2. J. Johnson, *Phytopathology* **31**, 679 (1941).
3. B. Kassanis and A. Kleczkowski, *J. Gen. Microbiol.* **2**, 143 (1948).
4. M. Weintraub and J. D. Gilpatrick, *Can. J. Botany* **30**, 549 (1952).
5. W. H. Sill and J. C. Walker, *Phytopathology* **42**, 349 (1952).
6. W. H. Greenleaf, *Phytopathology* **43**, 564 (1953).
7. J. E. Kuntz and J. C. Walker, *Phytopathology* **37**, 561 (1947).

2 June 1954.

Communications

Glycogen Deposits in Gingival Tissue

Glycogen deposits have been associated with keratin production in wound healing (*1*), hair growth (*2*), and cyclic changes in the endometrium (*3*), where the glycogen is regarded as a possible source of energy for the production of keratin. Heavy deposits of glycogen are present in the keratinized marginal epithelium of inflamed, human gingival tissue but not in the adjacent nonkeratinized crevicular epithelium that lines the gingival pocket. Gingival tissue from the gingival margin and interdental papilla was, therefore, examined (*4*) to see if any relationship existed; biopsy material was collected from 15 patients with clinically normal gingivae or only very slight marginal gingivitis and 41 with gingivitis or periodontitis.

In *normal gingivae* the marginal epithelium was keratinized and free from glycogen deposits. In the *inflamed gingivae,* where leucocytic infiltration of only the connective tissue occurred, glycogen was deposited in the superficial cells of the marginal epithelium where the ribonucleic acid (R.N.A.) content was low, irrespective of the state of keratinization of the epithelium. Glycogen was not deposited in those portions of the marginal or crevicular epithelium where leucocytic infiltration extended from the connective tissue into the epithelium; R.N.A. content was low in these areas.

Menkin (*5*) has shown that in inflammation in diabetics, protein of the damaged tissue is broken down to glucose (gluconeogenesis) with a resultant increase in glucose in inflammatory exudates. In nondiabetics, the glucose is usually removed by glycolysis, but it is suggested that, in the inflamed gingiva, the glucose is not all broken down. This glucose could diffuse out of sites of inflammation (*6*), and on a cellular level glucose could diffuse into and accumulate in adjacent epithelium and be stored as glycogen.

Concentration of R.N.A. is high where growth is taking place, and in my material glycogen was not deposited in the basal cells of the epithelium where the R.N.A. concentration was high; these cells apparently use any extra glucose in growth and cell division. In the Malpighian and more superficial layers, however, R.N.A. was low and mitotic figures entirely absent; these cells apparently do not use any extra glucose as a source of energy but deposit it as glycogen. These results are supported by observations made on skin (*7*).

The nonoccurrence of deposits of glycogen in the inflamed nonkeratinized crevicular epithelium may be explained by infiltration of this tissue by leucocytes and other elements; leucocytes possess both amylase and nuclease. It is known that some intercellular substance is lost in this region, so that enzymes could more readily diffuse into the epithelium, either from the gingival pocket or from the inflamed subepithelial zone; also glucose could more readily diffuse out of the epithelium.

It is suggested, therefore, that the reason for glycogen deposition in inflamed gingiva is the presence of excess glucose (from gluconeogenesis) that diffuses into the epithelium. The glycogen that is deposited is apparently from glucose in excess of that which might be needed for keratinization and other syntheses and appears to be a mechanism for disposal of unwanted glucose.

A detailed report of this work will be published in the *Journal of Periodontology.*

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References and Notes

1. J. R. G. Bradfield, *Nature* **167**, 40 (1951).
2. P. L. Johnson and G. Bevelander, *Anat. Record* **95**, 193 (1946).
3. G. B. Wislocki and E. W. Dempsey, *Am. J. Anat.* **77**, 365 (1945).
4. Aided by a grant from the National Health and Medical Research Council of Australia.
5. V. Menkin, *Am. J. Physiol.* **138**, 396 (1943).
6. R. G. Miller, *J. Exptl. Med.* **67**, 619 (1938).
7. W. Montagna, H. B. Chase, and W. C. Lobitz, *Anat. Record* **114**, 231 (1950).

16 April 1954.

Dust-Snow Storm in the Minneapolis–St. Paul Area on 12 March 1954

Dust storms are very common in the United States and have been discussed in the literature many times (*1*). The present notice is, therefore, only a local record on one of such storms in the Twin Cities. This dust-snow storm took place on Friday, 12 March 1954, after an extremely dry winter. In the early morning, the sky became yellowish-reddish in color, and the snow was a notably dirty, pinkish color. At places the dust accumulated on the surface of the snow, owing to sorting by the wind, which reached velocities of 40 to 50 mi/hr. Similar "red snow" was reported by the local press and radios over all of the upper Midwest as well as in other states. The snowfall on the next day was represented by usual pure white snow in Minneapolis. The dust was too fine for usual microscopic study, and only a few small angular quartz grains and some indeterminable organic (?) tissue have been observed. An x-ray study of the dust collected at the University of Minnesota, Minneapolis campus, showed the presence of quartz and feldspar patterns. The abundance of these two minerals was typical also for the dust storm in 1918 and other storms. The presence of quartz was recorded also on a thermodifferential curve made from the dust. The bitumina extraction of 2 g of dust with carbon disulfide in a Sohxlet-Allihn extractor showed a presence of lipoids in the amount of about 0.5 percent by weight. The origin of the red color of the snow is somewhat uncertain. It may be explained, perhaps, by the presence of small amounts of iron hydroxide pigment in the dust.

The water precipitated during the day of the storm, as reported by the weather bureau, was 0.66 in. A spot sample of snow collected on the campus showed 2.98 g of dust per liter of water. This gives an average amount of dust of 128.8 tons/mi². Even reducing this number to 50 tons because of the possibility of uneven distribution of dust, it would amount to a minimum of 75,000 tons of dust falling on the basic Twin City area—about 1500 mi².

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References

1. For example: A. B. Alexander, *Monthly Weather Rev.* **62**, 15 (1934); I. F. Hand, *ibid.* **62**, 156 (1934); L. R. Page and R. W. Chapman, *Am. J. Sci.* **26**, 288 (1934); A. N. Winchell and E. R. Miller, *ibid.* **46**, 599 (1918); **3**, 349 (1922); and *J. Agr. Research* **29**, 443 (1924).

14 June 1954.

On the Fluorometric Determination of N¹-Methylnicotinamide

Huff and Perlzweig (*1*) developed a fluorometric method for the estimation of N¹-methylnicotinamide based on the condensation of it with acetone under alkaline conditions. Huff (*2*) has shown the condensation product to be a highly fluorescent napthyridine derivative. More recently, Kato *et al.* (*3*) have reported that the intensity of fluorescence may be increased when samples of N¹-methylnicotinamide are treated with alkaline hydrogen peroxide before the analytic procedure is applied. We have found that pretreatment of samples with alkaline or neutral hydrogen peroxide may completely destroy N¹-methylnicotinamide, depending on the concentration and on length of time in which the samples are in contact with peroxide (*4*). Huff and Perlzweig have previously mentioned the rapid destruction of N¹-methylnicotinamide in alkaline solution.

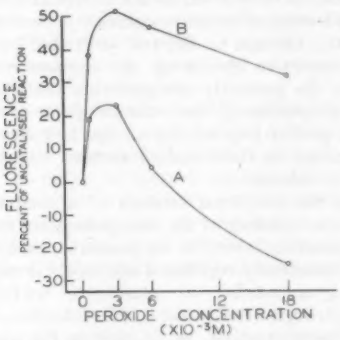

Fig. 1. Effect of hydrogen peroxide on the fluorescence of N¹-methylnicotinamide condensed with alkaline acetone: *A*, N¹-methylnicotinamide samples pretreated with neutral hydrogen peroxide; *B*, N¹-methylnicotinamide samples treated with hydrogen peroxide after the addition of acetone and alkali. Data obtained by the analytic procedure of Huff and Perlzweig (*1*) using 0.8 μg. N¹-methylnicotinamide in a final volume of 10 ml. The fluorescence of the uncatalyzed reaction was arbitrarily taken as zero.

Hydrogen peroxide, however, is effective in catalyzing the reaction when the peroxide is added to the reaction mixture after the acetone and alkali additions (Fig. 1). A plot of peroxide concentration versus the change in fluorescence from that of the uncatalyzed reaction demonstrates the concentration of peroxide necessary to obtain maximum fluorescence. At concentrations greater than the optimum, N¹-methylnicotinamide may be destroyed. Pretreatment of the samples with neutral hydrogen peroxide, immediately before application of the analytic procedure, resulted in a lower fluorescence response at the optimum concentration of peroxide and in greater destruction of N¹-methylnicotinamide at high concentrations of peroxide.

The data also indicate the necessity for rigid control of peroxide concentrations in order to obtain reproducible results.

In a study of the factors affecting the analytic procedure, we have found that a large number of inorganic elements catalyze the formation of a fluorescent derivative. Iridium and cerium salts have the greatest activity at concentrations of 5×10^{-6} and 8×10^{-6} M, respectively. These salts are almost 1000 times more active than hydrogen peroxide at optimum concentrations. A complete report of the factors affecting the formation of the napthyridine derivative is in preparation and will be published elsewhere.

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References and Notes

1. J. W. Huff and W. A. Perlzweig, *J. Biol. Chem.* **167**, 157 (1947).
2. J. W. Huff, *J. Biol. Chem.* **167**, 151 (1947).
3. M. Kato, H. Shimizu, and Y. Hamamura, *Science* **116**, 462 (1952).
4. A preliminary report of this work was presented before the Division of Biological Chemistry, American Chemical Society, Sept. 1953.

5 February 1954.

A New Enemy of the Oyster Drill

It has been reported that the oyster drill, *Urosalpinx cinerea* (Say), and *Eupleura caudata* (Say) is its own worst predator (*1*). However, the moon snail, *Polinices duplicata* (Say), may in some areas destroy more oyster drills than the drills themselves destroy.

Dead drills from the Lower Miah Maull area of Delaware Bay, 937 in number, were examined for cause of death. Of these, 100 contained the large, heavily countersunk hole typical of the moon snail, and 76 contained the small, slightly countersunk hole typical of the oyster drill. These dead drills were obtained from material removed from the leased oyster beds by drill screens and a drill dredge. Drill screens and drill dredges are screening devices used by the oystermen to remove drills from their oyster beds.

To check these field observations, 23 oyster drills and three moon snails were placed together in a laboratory aquarium. At the end of 4 mo, one moon snail and one oyster drill were alive. The other two moon snails and 22 drills had been eaten by the moon snail(s).

It is possible that some cases of drill death previously attributed to cannibalism were cases of moon snail predation.

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Reference

1. L. A. Stauber, *Ecological Studies of the Oyster Drill* Urosalpinx cinerea *in Delaware Bay with Notes on the Associated Drill* Eupleura caudata, *and with Practical Consideration of Control Methods*, unpublished manuscript, Oyster Research Laboratory, N.J. Agr. Expt. Sta., 1943, p. 91.

4 June 1954.

Brochosomes and Leafhoppers

Brochosomes (Gr. βρόχος, mesh of a net; σῶμα, body) are hollow spheroids varying in diameter from 240 to 600 mμ which, because of a fixed arrangement of high and low electron-scattering areas, appear as netted bodies. They are found on the wings, wing scales, and hairs of many insects [G. S. Tulloch and J. E. Shapiro, *Bull. Brooklyn Ent. Soc.* **48** (3), 57 (1953)]. Their regular occurrence on a large number of leafhoppers representing several species from widely separated areas in the United States suggested that the brochosome-leafhopper association was not a casual one. Further studies dealing with the geographic range of this relationship are reported here along with data obtained by following the development of one species of leafhopper from egg to adult.

Leafhoppers were obtained from many sources throughout the world and prepared for examination under the electron microscope in the following manner. Wings were removed and placed in a drop of water on Formvar-filmed 200-mesh screening and allowed to dry at room temperature. By this technique, the wing is flattened and fixed to the film and some of the brochosomes, which are easily dislodged, are pulled to the periphery of the drop of water and there become fixed to the clear film. As a result of this survey, leafhoppers positive for brochosomes have been recorded from the United States, Mexico, Panama, Cuba, Jamaica, Peru, Belgian Congo, India, Pakistan, and China. Thus far, not a single leafhopper, regardless of its geographic origin, has been found free of brochosomes. Although material from Europe and Australia has not been examined, there is good indication from the available data of the universal nature of the brochosome-leafhopper association.

Other studies have been concerned with the presence or absence of brochosomes in the egg and in the several instars found in the development of the aster leafhopper, *Macrosteles divisus*, obtained from a laboratory colony. The eggs were removed from the host-plant tissues and from the female, macerated in a drop of water, and allowed to dry on the Formvar film. Since the early instars lack wings or wing pads, body fluids were utilized by employing the smear technique. For the older instars, the wings were mounted directly on the Formvar. Examination of these preparations under the electron microscope revealed that (i) eggs removed from the female as well as those dissected from plant tissues 1 and 8 days following deposition were negative; (ii) all specimens from the different instars, prepared either from body fluids or wing surfaces, were positive, although the body fluid material (instars I and II) gave a smaller brochosomal yield than the wings of the later instars.

The close association of brochosomes and leafhoppers both geographically and developmentally indicates that this relationship is not fortuitous. The presence of brochosomes in the body fluids suggests that they may be metabolic derivatives which reach the surface of the body through the pore canals.

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21 May 1954.

Limitations of the Symmetry Criteria for Optical Inactivity and Resolvability

Renewed interest in the subject of optical inactivity (*1*) has stimulated the present inquiry into the generality of symmetry criteria.

The criteria employed for predicting optical activity or nonactivity from a knowledge of the structure of a compound have evolved, in the historical sense, from Pasteur's original broad recognition of molecular dissymmetry, through Le Bel and van't Hoff's somewhat more restrictive theory of the asymmetric carbon atom, to the presently accepted view that from symmetry properties of the molecule alone one may be able to predict resolvability or the lack thereof (*2*). These views, in their modern context, may be stated briefly as follows.

Given the structural formula of a compound and some understanding of the energy barriers restricting bond distortion, it may be supposed that each molecule in the statistically significant aggregate is capable of assuming a number of reasonable conformations which, through bond rotation and distortion, are mutually interconvertible. In all cases so far considered, without exception, there exists at least one conformation (the "symmetry conformation") that possesses reflection symmetry—mirror-axes, for example, point, plane, or four n-fold alternating axis of symmetry; this conformation can be superimposed on its mirror image by the application of symmetry operations alone. The remaining dissymetric conformations are evenly distributed between nonsuperimposable enanti-

omers, representing in their totality a large number of transient dl-pairs. According to the presently accepted symmetry criteria, the availability of any symmetry conformation(s) is deemed sufficient basis for declaring the molecular aggregate optically inactive and nonresolvable. Thus, for example, the fact that one symmetry conformation may ordinarily be written for 2,2′diphenic acid, or two for meso-tartaric acid, is enough to predict the optical inactivity of either compound. Conversely, the absence of symmetry conformations permits the prediction of optical activity, or resolvability in the case of racemic mixtures.

The usefulness of symmetry criteria is evident, yet it is a remarkable fact that apparently no cases constituting exceptions to this doctrine have heretofore been considered as such. Since the sole necessary criterion for optical inactivity is the presence, in the molecular system, of an equal number of conformational and/or configurational enantiomers, it was tempting to postulate a case of an optically inactive and configurationally pure compound not possessing a symmetry conformation. Consider, for example, the hypothetical structure shown in Fig. 1. It may be assumed that rotation is virtually free about bonds *a*, whereas rotation about bond *b* is effectively restricted to eliminate conformations containing a planar biphenyl system. Compounds possessing the structural features illustrated may exist in three stereoisomeric modifications: d,l, and meso. It must now be emphasized that *no conformation conceivable for the meso modification possesses reflection symmetry*; that is, the symmetry criteria are here no longer applicable. Although any given conformation having the planes of the phenyl rings at right angles to one another cannot possibly be superimposed upon its enantiomer through the application of symmetry operations alone, an interconversion between the enantiomers will still take place by virtue of rotation around bonds *a*. In consequence, the molecular aggregate, consisting exclusively of transient dl-pairs, is optically inactive and not resolvable, in the operational sense that meso-tartaric acid is not resolvable.

It must be noted that this case is dissimilar to superficially analogous cases such as $(a^+)(a^+)C(a^-)(a^-)$, where a^+ and a^- represent dissymetric groupings (for example, sec.-butyl) of opposite configuration: such a compound possesses a symmetry conformation having a fourfold alternating axis of symmetry.

One additional aspect of interest in the situation here outlined is that conformational racemization, in the case of this type of compound, cannot proceed via a symmetric intermediate. It follows that in general a symmetric intermediate need not, and sometimes cannot, be invoked to account for racemization.

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W. H. Nichols Chemical Laboratory,
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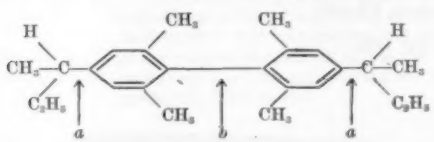

Fig. 1. *Meso*-4,4′—Di(sec.-butyl)-2,6,2′,6′-tetramethylbiphenyl, example of a molecule possessing no alternating axis of symmetry.

References

1. See, for example, C. R. Noller, *Science* **102**, 508 (1945); G. W. Wheland, *Advanced Organic Chemistry* (Wiley, New York, ed. 2, 1949), pp. 147, 191; K. Mislow, *Science* **112**, 26 (1950); R. W. Hakala, *ibid.* **113**, 15 (1951); D. F. Mowery, Jr., *J. Chem. Educ.* **29**, 138 (1952); R. L. Bent, *ibid.* **30**, 328 (1953).
2. See F. M. Jaeger, *Spatial Arrangements of Atomic Systems and Optical Activity* (McGraw-Hill, New York, 1930), chaps. 1–4.

27 May 1954.

Some Problems Concerning the Distribution of the Late Paleozoic Gastropod *Omphalotrochus**

The genus *Omphalotrochus* Meek is a wide-ranging stratigraphically significant gastropod. Its importance has received acknowledgment in designation of the *Omphalotrochus* zone in the Moscow basin of Russia. This zone is classified by most Russian geologists as Upper Carboniferous and is correlated with beds underlying the *Pseudoschwagerina* zone (*1*). The base of the *Pseudoschwagerina* zone is considered by some Russian and many American geologists to mark the base of the Permian system.

In other areas of Russia, *Omphalotrochus* occurs in the *Pseudoschwagerina* zone. For this reason, and because *Omphalotrochus* had not been reported from beds below those correlated with the American Wolfcamp formation, Knight suggested that the "*Omphalotrochus* beds of the Timan arch [Russia] should be included with the *Pseudoschwagerina* beds and that they, together with the intervening *Cora* beds, are the Russian equivalent of the American Wolfcamp series" (*2*). He tentatively referred the entire interval to the basal Permian, but so far as is known, this suggestion has not been adopted by Russian geologists. The purpose of this note is to record other occurrences of *Omphalotrochus* and to mention the implications of these findings in correlation of strata of late Paleozoic age.

The west Texas Wolfcamp formation contains, among other fossils, *Pseudoschwagerina* and *Omphalotrochus*. *Omphalotrochus* has been collected recently from the upper part of the *Uddenites* zone, directly below the Wolfcamp formation, but *Pseudoschwagerina* appears to be lacking from this zone.

Most American geologists dealing with upper Paleozoic stratigraphy consider the Wolfcamp formation to be the approximate equivalent of the Russian *Pseudoschwagerina* zone and classify it as lower Permian or Permian (?). The age of the *Uddenites* zone has been a controversial subject, some stratigraphers

considering it Permian and others Pennsylvanian (Upper Carboniferous). Most published opinion at present favors a Pennsylvanian age.

The presence of *Omphalotrochus* in the *Uddenites* zone, below *Pseudoschwagerina*, suggests that the range of the genus is similar in Russia and west Texas. According to last-known stratigraphic assignments of the Russian type Permian section (*1*), *Omphalotrochus* is not a "guide fossil" to the Permian but would rather be indicative of late Carboniferous age. If the *Uddenites* zone is considered Permian, then the Moscow basin is the only area where *Omphalotrochus* occurs below rocks that a large group of geologists classify as basal Permian. An alternative is to consider the *Omphalotrochus* zone as a faunal facies of the lower part of the *Pseudoschwagerina* zone—essentially what Knight suggested.

Within the United States, *Omphalotrochus* is known from California, Nevada, Wyoming, Arizona, New Mexico, west Texas, north-central Texas, and Kansas. It ranges from the *Uddenites* zone to Permian beds, correlated with the Leonard formation, above the Wolfcamp. My study suggests that there are more than the two species now described from North America. Discrimination of these several species may show that they have value for regional correlation. *Omphalotrochus ferrieri* Girty and *Omphalotrochus conoideus* Girty, described from the Phosphoria formation, probably should be referred to another genus.

The geographic distribution of species of this genus needs further study. For example, *O. whitneyi* (Meek) from California (McCloud limestone-Permian?) may occur in west Texas. A specimen similar to *O. whitneyi* has been illustrated from the Donetz basin, and the species has been reported from the Timan area (*3*). If these and the American form are conspecific, this species ranges from latitude 65°N to 32°N.

Omphalotrochus obtusispira (Shumard), from west Texas (Hueco limestone-Permian?) has been reported from Peru (*4*). A remarkably similar species, *O. gerthi* Wanner, has been named from Indonesia (*5*). Insofar as one can tell from illustrations, these two named species could be conspecific. If this is so, the species has a geographic range not only from 32°N latitude to 15°S latitude, but also halfway around the world.

These afore-mentioned ranges are remarkable for any benthonic animal, living or fossil. If the possible identity of species and their distributions mentioned are substantiated, they will support the idea of widely uniform climatic conditions and interconnected shallow migration routes during late Paleozoic time.

ELLIS L. YOCHELSON

U.S. Geological Survey, Washington 25, D.C.

References and Notes

[6] Publication authorized by the Director, U.S. Geological Survey.

1. I. I. Gorsky *et al.*, *The atlas of the leading forms of the fossil faunas of U.S.S.R.*, vol. 5, *The middle and upper Carboniferous* (Central Geological and Prospecting Inst., Leningrad, 1939), table, p. 26.
2. J. B. Knight, *Bull. Am. Assoc. Petroleum Geol.* **24**, No. 6, 1128 (1940).
3. B. K. Licharew, *Compt. rend. acad. sci. U.R.S.S.* **27**, No. 3, 301 (1940).
4. B. J. Chronic, in N. D. Newell *et al.*, *Upper Paleozoic of Peru* (Columbia Univ. Press, New York, 1949).
5. C. Wanner, in H. A. Brouwer, *Geological Expedition to the Lesser Sunda Islands* (N. V. Noord-Hollandsche Uitgevers Maatschappi, Amsterdam, 1942).

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5–9. National Assoc. of Biology Teachers, Gainesville, Fla. (J. P. Harrold, 110 E. Hines St., Midland, Mich.)

5–9. The Nature Conservancy, Gainesville, Fla. (G. B. Fell, 607 G St., SE, Washington 3, D.C.)

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5–9. Soc. for the Study of Evolution, Gainesville, Fla. (H. Lewis, Dept. of Botany, Univ. of California, Los Angeles 14.)

5–10. Laurentian Hormone Conf., Mont Tremblant, Que., Canada. (G. Pincus, 222 Maple Ave., Shrewsbury, Mass.)

6–8. Symposium on Inorganic Chemistry, IUPAC, Münster, Germany. (R. Delaby, 4 Ave. de l'Observatoire, Paris 6.)

6–9. American Forestry Assoc., annual, Portland, Ore. (AFA, 919 17 St., NW, Washington 6, D.C.)

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6–10. International Conf. of Geographic Pathology, 5th, Washington, D.C. (R. A. Moore, School of Medicine, Washington Univ., St. Louis 10, Mo.)

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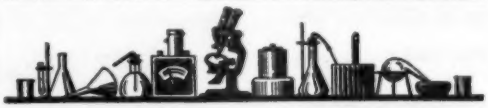

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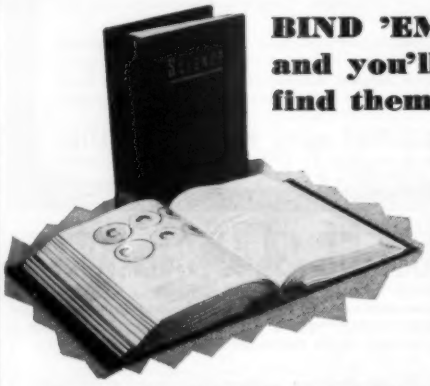

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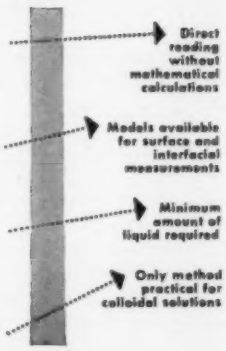
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